THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXVIII. No. 2001.] LONDON, SEPTEMBER 17, 1901. [53RD YEAR. PRICE 6d.

PARKER & LESTER.

— *ESTABLISHED 1830* —

MANUFACTURERS AND CONTRACTORS, **ORMSIDE STREET, LONDON, S.E.**

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT & PARKER'S IMPERIAL BLACK VARNISH.

OXIDE PAINTS, OILS, AND GENERAL STORES, FOR GAS AND WATER WORKS,

SAFETY GAS-MAIN STOPPER,

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS.

GAS-LEAK INDICATOR.

PRICES AND PARTICULARS ON APPLICATION.

GAS AND WATER PIPES

1½ to 12 in. BORE.

THOMAS ALLAN & SONS, LIMITED,

Bonlea Foundry,

THORNABY-ON-TEES.

Formerly Springbank Iron-Works, Glasgow.

ESTABLISHED 1848.

Also Manufacturers of

SANITARY & RAIN-WATER PIPES, HOT WATER PIPES, STABLE FITTINGS, RANGES, STOVES, And GENERAL CASTINGS.

Telegrams: "BONLEA, THORNABY-ON-TEES."

NORTON'S PATENT

"ABYSSINIAN" & ARTESIAN TUBE WELLS,

FOR TOWN WATER-WORKS AND OTHER SUPPLIES.

The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.

LE GRAND & SUTCLIFF,

HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

EVERYONE IS SAYING

"If you want to see the Most Successful Destructor and Electric Light and Traction Installation

"GO TO DARWEN."

For Full Particulars apply to

MELDRUM BROTHERS, LIMITED,

ATLANTIC WORKS, MANCHESTER;

And 66, VICTORIA STREET, WESTMINSTER, where a complete Model may be seen.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE)

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765).

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

Telegrams: "COCKEYS, FROME." **EDWARD COCKEY & SONS, LTD.,** *Telegrams:* "DAMPER, LONDON."

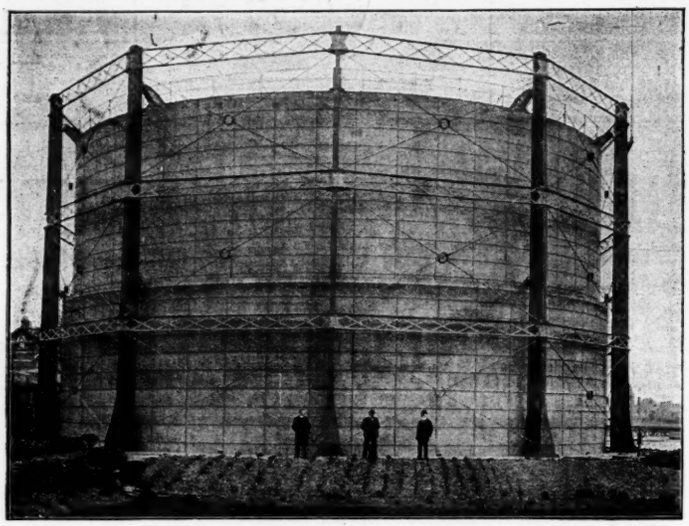
GASHOLDERS IN EITHER STEEL OR WROUGHT IRON.

GASHOLDER TANKS IN STEEL, WROUGHT OR CAST IRON.

CAST-IRON COLUMNS.

STEEL or WROUGHT IRON STANDARDS. *(Any Section.)*

INLET and OUTLET PIPES in either CAST or WROUGHT IRON, or STEEL.



HYDRAULIC MAINS.
FOUL MAINS.
CONDENSERS.
RETORT-LIDS.
PURIFIERS.
HYDRAULIC LIFTS.
ROOFS.
BOILERS in either WROUGHT IRON or STEEL.

LAMP COLUMNS, MAIN PIPES, and IRREGULARS always in Stock.

THE IRON-WORKS, FROME, SOMERSET.

London Office: 181, QUEEN VICTORIA STREET, E.C. *BALE & HARDY, Agents.*

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—

MANUFACTURERS OF TUBES AND FITTINGS OF EVERY DESCRIPTION.

WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

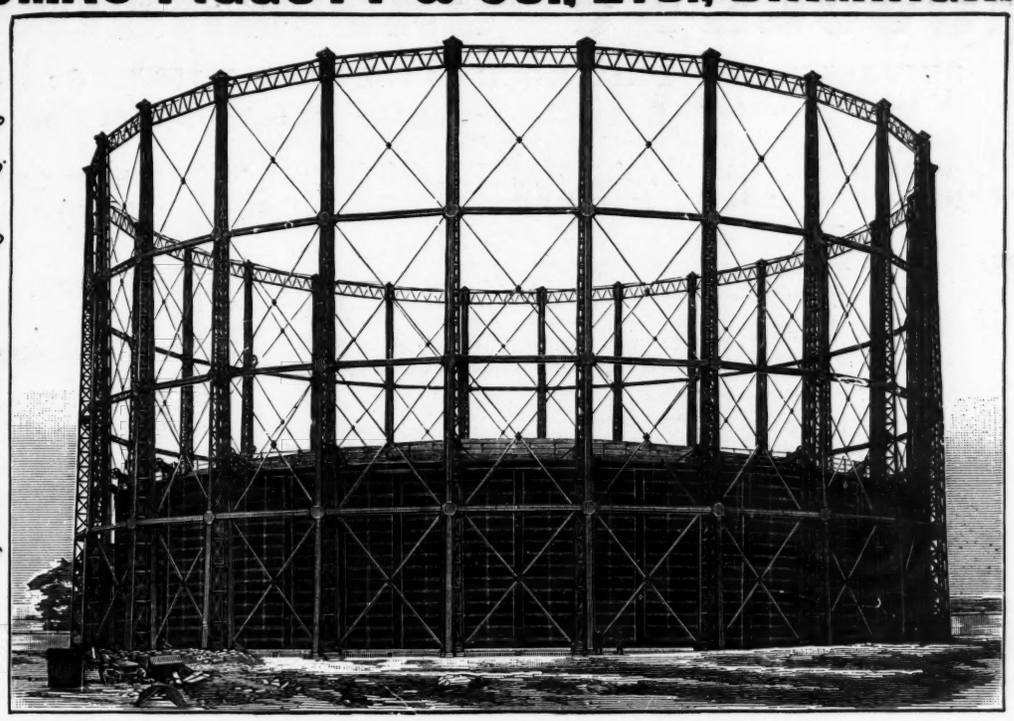
SCREWING TACKLE, BOILER MOUNTINGS, VALVES, COCKS, ETC.

LONDON: 108, Southwark Street. MANCHESTER: 33, King Street West, BIRMINGHAM: 114, Colmore Row. LEEDS: 6, Mark Lane, New Briggate.

THOMAS PIGGOTT & CO., LTD., BIRMINGHAM.

LONDON OFFICE ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT. FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS BIRMINGHAM

WELDED & RIVETED PIPES, FOUL MAINS, RETORT. LIDS, WROT & CAST TANKS, PURIFIERS.

MANUFACTURERS OF

Humphreys & Glasgow's Patent Carburetted Water-Gas Plant.

INSTALLATIONS HAVE ALREADY BEEN SUPPLIED, AND ARE IN HAND FOR THE FOLLOWING GAS-WORKS:—

COPENHAGEN
BELFAST
BRUSSELS
LIVERPOOL
TOTTENHAM
SWANSEA
MANCHESTER
BRIGHTON
PRESTON
SOUTHPORT
BATH
HOYLAKE
COVENTRY
WINCHESTER
SHANGHAI
STOCKPORT
NORWICH
LEA BRIDGE
DUNEDIN (N.Z.)
HULL
STAINES
EDINBURGH
GOSPORT
STAFFORD
STOCKTON-ON-TEES
TUNBRIDGE WELLS
GUILDFORD
COMMERCIAL GAS CO.
BRIDLINGTON
MIDDLESBROUGH
CROYDON
L. & N.W. RY., CREWE
TAUNTON
ROTTERDAM
DORKING
G.L.&C. CO., BROMLEY
DURHAM
SCARBOROUGH
PERTH (W.A.)
BREMEN
LINCOLN
LONGTON
COLNEY HATCH
SYDNEY (Harbour)
SYDNEY (Mortlake)
ANTWERP
BIRMINGHAM
HEBDEN BRIDGE
MAIDENHEAD
EPSOM
NORTH MIDDLESEX
WANDSWORTH
AARHUS
FALMOUTH
SOUTHAMPTON
HARTLEPOOL
UTRECHT
DEVENTER
PORTSMOUTH
BOURNEMOUTH
AYLESBURY
HAMBURG
DUBLIN
REDHILL
FAVERSHAM
CHORLEY
LIÉGE
BRENTFORD
WALTHAM
THE HAGUE
ROMFORD
CARLISLE

REPEATED CONTRACTS.

TOTTENHAM (2nd)
TOTTENHAM (3rd)

REPEATED CONTRACTS.

TOTTENHAM (4th)
COPENHAGEN
BELFAST
BRUSSELS (2nd)
BRUSSELS (3rd)
BRUSSELS (4th)
LIVERPOOL
COVENTRY
LEA BRIDGE
MAIDENHEAD
COMMERCIAL (2nd)
COMMERCIAL (3rd)
COMMERCIAL (4th)
G.L. & C. CO., NINE ELMS
G.L. & C. CO., BECKTON
G.L. & C. CO., BECKTON (2nd)
G.L. & C. CO., FULHAM
BRIGHTON
STOCKPORT
CROYDON
MANCHESTER
DUBLIN
SOUTHAMPTON
BRIDLINGTON
SWANSEA (2nd)
REDHILL (2nd)

THE WIGAN COAL & IRON CO., LIMTD.,

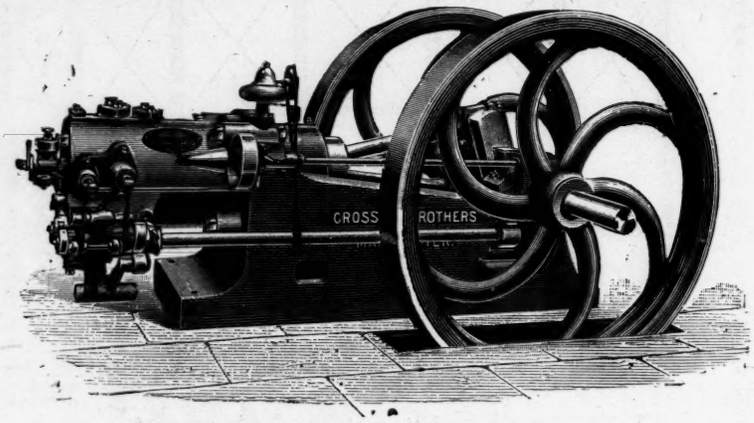
Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

Midland and West of England District Office: 6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.
Telegraphic Address: "WIGAN, BIRMINGHAM." Telephone No. 200.

London District Office: 6, STRAND, LONDON—C. PARKER & SON, Sole Agents.
Telegraphic Address: "PARKER, LONDON."

CROSSLEY'S GAS-ENGINES

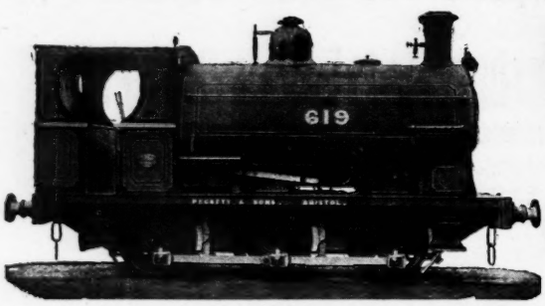
SUITABLE FOR DRIVING EXHAUSTERS, PUMPS, &c.



Represents "U" Type giving 32 Effective Horse Power.

Large Number of Second-Hand Engines always in Stock.

CROSSLEY BROS., LTD., OPENSHAW, MANCHESTER.



LOCOMOTIVES

LOCOMOTIVES of all Sizes and Gauges specially constructed for Main and Branch Lines, Contractors, Docks, Gas-Works, Collieries, Iron-Works, Brick and Cement Works, &c. Locomotives of various Sizes always in Stock, ready for immediate Delivery.

Photographs, Specifications, and Prices on Application.

PECKETT & SONS, Atlas Locomotive Works, BRISTOL.

Telegraphic Address: "PECKETT, BRISTOL."

NEWTON, CHAMBERS, & CO.,

LIMITED,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.

Established 1790

LONDON OFFICE: **19, Great George Street, WESTMINSTER.**

Telegraphic Addresses: "NEWTON, SHEFFIELD," "ACCOLADE, LONDON."

GAS ENGINEERS, IRONFOUNDERS, & CONTRACTORS.

Manufacturers of every description of

PLANT, APPARATUS, and MACHINERY for GAS and CHEMICAL WORKS.

RETORTS and FITTINGS, MOUTHPIECES with Self-Sealing Lids.

Improved COAL and COKE HANDLING PLANT, CONVEYORS, and ELEVATORS,

CONDENSERS, SCRUBBERS, and WASHERS.

PURIFIERS with Planed Joints a Speciality.

Patent CENTRE-VALVES, RACK and SCREW VALVES, WOOD GRIDS, and SCRUBBER-BOARDS, CAST-IRON MAINS, and SPECIALS.

STRUCTURAL WORK, COLUMNS, GIRDERS, and ROOFING.

GASHOLDERS, Cast-Iron or Steel Tanks.

DESIGNS, SPECIFICATIONS, and ESTIMATES FREE.

PIG IRON (Special Quality) for Engine Cylinders. GAS COAL famous for its UNRIVALLED EXCELLENCE.

The LEEDS FIRECLAY CO., LD.,

Telegrams: "SETTINGS, LEEDS." Telephone: No. 1332.

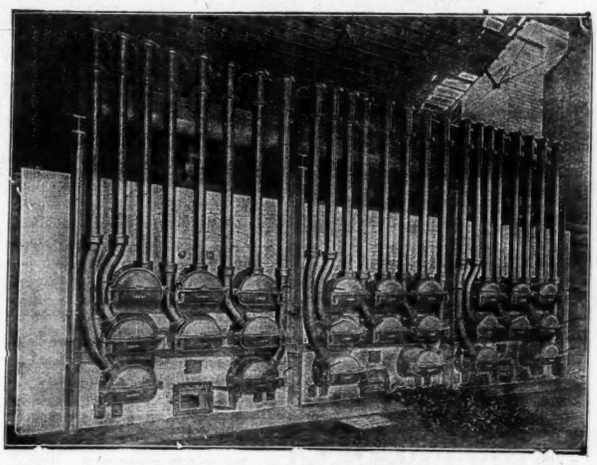
WORTLEY, LEEDS.

ENGINEERING DEPARTMENT

RETORT

INCLINED,
HORIZONTAL,
REGENERATOR,
GENERATOR,
AND
DIRECT FIRED.

RETORTS RE-SET.



SETTINGS

SHALLOW REGENERATORS
A SPECIALITY.

NUMEROUS TESTIMONIALS

GUARANTEED RESULTS EXCEEDED IN MOST INSTANCES.

SOLE MAKERS OF HUDSON & RANN'S PATENT AUTOMATIC CHIMNEY DRAUGHT REGULATOR.

MOUTHPIECES, WITH SELF-SEALING OR LUTED LIDS.
BENCH, FURNACE, AND FLOOR IRONWORK ROOFS.
CONDENSERS, WASHERS, SCRUBBERS.
PURIFIERS, GASHOLDERS, &c.
COAL & COKE BREAKING, ELEVATING, & CONVEYING MACHINERY.
— CONTRACTORS FOR COMPLETE GAS-WORKS. —

INCLINED RETORTS.

HORIZONTAL RETORTS.

RETORT BENCHES AND SETTINGS,
WITH
GENERATOR OR REGENERATOR FURNACES.

W. J. JENKINS & CO., Ltd., RETFORD.

MOBBERLEY & PERRY
STOURBRIDGE.

Manufacture & supply best quality of
Gas Retorts (SEGMENTAL, HORIZONTAL, OR INCLINED.)
Special Bricks & Blocks for GENERATOR & REGENERATOR FURNACES.
FIRE BRICKS, LUMPS, & TILES, BLUE STAFFORDSHIRE VITRIFIED BRICKS FOR PAVING, &c, &c.
EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.
London Agents: Contractors for the erection of Retort-Benches complete.

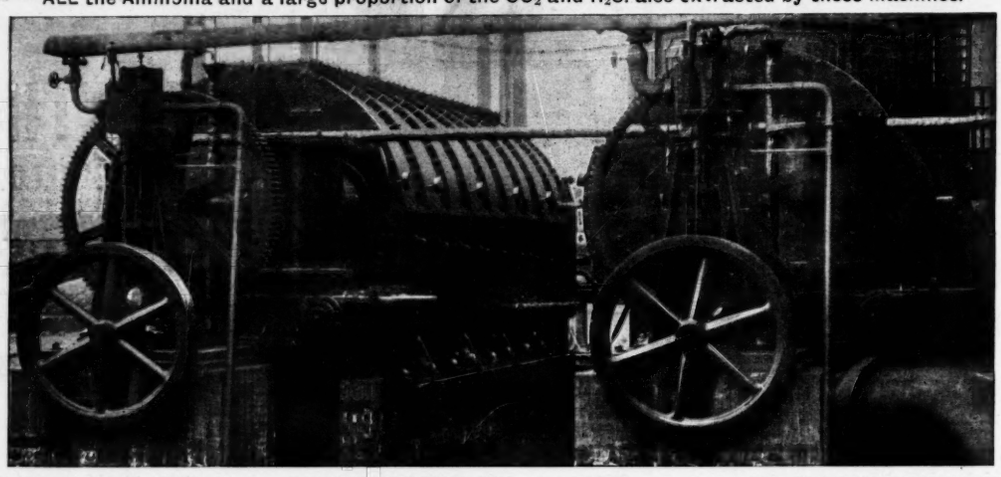
BALE & HARDY, Gas Engineers and Contractors,
BRIDGE HOUSE, 181, QUEEN VICTORIA STREET, E.C.

Naphthalene extracted by the YOUNG & GLOVER PROCESS as applied to—

PATENT "STANDARD" WASHER-SCRUBBERS.

ALL the Ammonia and a large proportion of the CO_2 and H_2S. also extracted by these Machines.

Prevention of Slip of Gas Unwashed.
Strength of Liquor Concentrated.



Maximum Washing Surface.
Easy access to interior.

KIRKHAM, HULETT, & CHANDLER, LD., PALACE CHAMBERS, BRIDGE STREET, **WESTMINSTER, S.W.**

AGENTS for the YOUNG and GLOVER PROCESS.

HARRIS & PEARSON,

STOURBRIDGE, ENGLAND.

MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

GLAZED BRICKS AND PORCELAIN BATHS.

THE GAS-METER COMPANY, LIMITED.

MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.

STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM (Late WEST & GREGSON). Established 1830.

For Prices and Particulars apply to

F. W. CHURCH, Secretary.

Works: 238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

[See Advertisement on back of Wrapper.

"CANNON" SLOT COOKERS.

THE "VILLA."

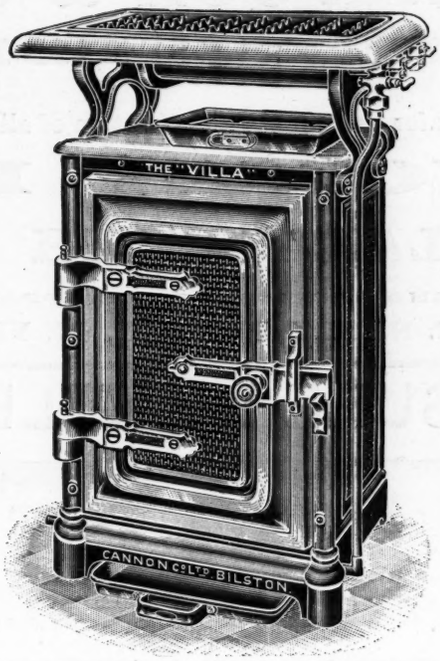
IN TWO SIZES.

OVENS:

12 x 12 x 19 inches

AND

14 x 12 x 19 inches.



THE "VILLA."

IN GREAT DEMAND.

PROMPT DELIVERY GUARANTEED.

A LARGE VARIETY OF OTHER PATTERNS AND SIZES. SPECIAL QUOTATIONS FOR QUANTITIES.

CANNON IRON FOUNDRIES, LIMITED

Gas-Stove Department.

Head Office and Works: DEEPFIELDS, NEAR BILSTON, STAFFS.

London Office and Show-Room: BATH HOUSE, 57-60, HOLBORN VIADUCT, E.C.

Telephone No. 103. Telegraphic Address: "ELEVATOR, HASLINGDEN."

S. S. STOTT & CO.,

ENGINEERS, HASLINGDEN, NR. MANCHESTER.

COAL AND COKE ELEVATORS & CONVEYORS.

COAL AND COKE STORAGE PLANTS.

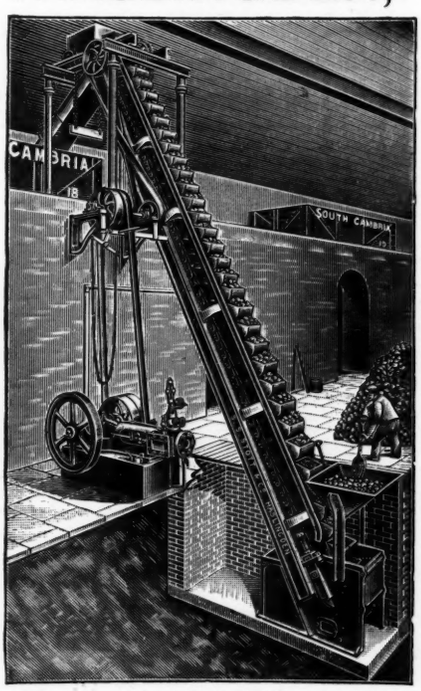
COAL AND COKE BREAKERS.

WHARF ELEVATORS FOR UNLOADING BARGES.

ELEVATORS & CONVEYORS for BOILER-HOUSES.

STAMPED AND RIVETED STEEL ELEVATOR BUCKETS.

DETACHABLE CHAINS AND SPROCKET WHEELS.



Coke Elevator Loading Railway Waggons.

LIME AND OXIDE ELEVATORS & CONVEYORS.

HIGH-CLASS STEAM-ENGINES up to 1000-Horse Power

PUMPS, HORIZONTAL AND VERTICAL, SINGLE, DOUBLE, or THREE-THROW, for WATER-WORKS, &c.

BEAM PUMPING-ENGINES.

AIR-COMPRESSORS.

BELT PULLEYS, ROPE PULLEYS, GEARING, &c., &c.

HENRY BALFOUR & CO., LTD.,

LEVEN, FIFESHIRE.

Contractors for the Supply and Erection of all Classes of

GAS-WORKS PLANT.

THE "ANNULAR" BRUSH SCRUBBER.

PRICES AND PARTICULARS ON APPLICATION.

London Representative: MR. HENRY PUPLETT, 47, VICTORIA STREET, S.W.

HIGH PRESSURE MANTLES.—*A SPECIALITY.*

Uniform.

Brilliant.

Durable.

Unshrinkable.

None genuine unless stamped "DURA."

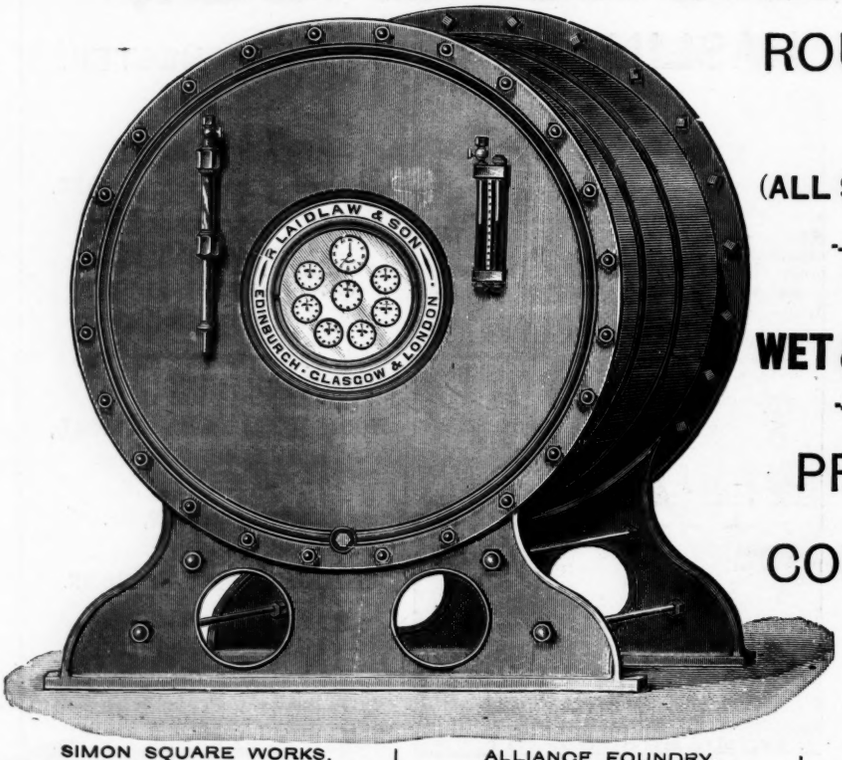
Liberal Terms to Gas Companies and Corporations. British made by British Labour.

THE GUARANTY INCANDESCENT MANTLE CO., BALHAM HILL, LONDON, S.W.

Telegrams: "UNLIMITED, LONDON."

R. LAIDLAW & SON, LIMITED,

GAS & WATER ENGINEERS.



ROUND OR SQUARE STATION (ALL SIZES) METERS.

CONSUMERS'

WET & DRY GAS-METERS.

PREPAYMENT AND COMPENSATING METERS.

SIMON SQUARE WORKS, **EDINBURGH.** | ALLIANCE FOUNDRY, **GLASGOW.** | 6, LITTLE BUSH LANE, **LONDON, E.C.**

CONTENTS.

EDITORIAL NOTES.

GAS, LIGHTING, &c.—
The Welsbach Patent of 1893—An Apology 687
Professor Rücker's British Association Address 687
Professor Lewes's New Experiments in Gas Manufacture 688
The Outlook in the Coal and Iron Trades . 689
Wages and Hours of Labour 689
Further Consequences of the Taff Vale Railway Case 690
Waverley Association Meeting 690

INTERNATIONAL ENGINEERING CONGRESS.

GAS SECTION—
Papers and Discussions—
The Production of Illuminating Gas from Coke-Ovens. By F. Schniewind, Ph.D. 691
The Principles of Construction of a Proposed Modern Gasholder for Amsterdam. By J. van Rossum du Chattel . 706

ESSAYS AND REVIEWS.

The Labour Market in 1900 713
Gas and Water Stock Market 714

NOTES.

Facilitating Respiration in Deleterious Atmospheres 715
Dr. Glazebrook on Wind Pressures . . . 715
The Value of Blast-Furnace Gases. . . . 715

TECHNICAL RECORD.

Manchester District Institution of Gas Engineers—Quarterly Meeting at Grantham—
General Business 716
Paper by Mr. Shadbolt 716
Visit to the Grantham Gas-Works . . . 716
Waverley Association of Gas Managers—Half-Yearly Meeting at Musselburgh . . 716
Grantham and Its Gas Supply 719
The Conservation of Our Coal Resources. . 721

REGISTER OF PATENTS.

Apparatus for Mixing Gases—Boult, A. J. (Molet, A.) 723
Gas-Pressure Recorder — Thorp, T., and Marsh, T. G.. 723
Coin-Freed Apparatus—Jackson, E. . . . 723
Mixing Oxygen with Lighting or Heating Gas, either Previously Formed or Simultaneously Generated as Carburetted Air—Dannert, F. 723
Coke Conveyors—Cliff, W. D., and Sugden, F. C. 723
Purifying Gas—Prégardien, J. E. 723
Patent Notices 724

CORRESPONDENCE.

Coal Statistics 724

LEGAL INTELLIGENCE.

High Court of Justice—Chancery Division—The Welsbach Incandescent Gaslight Company, Limited, *v.* The United Chemical Works and Julius Norden, and in the Matter of Walter King 725
Alleged Intimidation by Cork Gas Strikers . 725
Failure to Supply Electricity to Private Consumers 725
After-Effects of the Cork Gas-Works Strike . 725

MISCELLANEOUS NEWS.

Sheffield United Gas Company. 726
Harrow and Stanmore Gas Company . . . 726
Metropolitan Gas Company of Melbourne . 727
Australian Gaslight Company 727
Carlisle Corporation Gas Accounts — The Profits and the Rates 728
Devonport Corporation and the Gas-Works—Charges for Gas in the Naval and Military Establishments 728
Analysis of Ammoniacal Liquors 729
Electric Lighting Notes 730
The Sheffield Water Committee's Surplus—Suggestions for Its Employment. . . . 730
The Water Board for Southport, Birkdale, and West Lancashire 731

MISCELLANEOUS NEWS (*continued*)—

Portsmouth Corporation and the Water-Works—Abandonment of the Purchase Scheme . 731
Stockport Corporation Finances—The Gas, Electricity, and Water Departments . . 731
Stock and Share List 732
Notes from Scotland 733
Current Sales of Gas Products 734
Coal Trade Reports 735

PARAGRAPHS.

Directors' Magnanimity and Employees' Loyalty 713
Railway Station Lighting by Incandescent Gas-Lamps—Coke for Treating Sewage . 714
Obituary. 715
Liquefaction of Coal Gas. 721
A Town in Darkness—Bingley and the Purchase of the Cullingworth Gas-Works—Reductions—Scaffold Accident at Clay Cross—St. Albans Gas Company—Suicide by Gas—Suffocation by Gas 725
New Joint-Stock Company—Cork Gas Strike—Position of the Manchester Water Supply—Softening Stockport Water—Rural Water Supplies—Water-Works for Leeds in the Burn and Laver Valleys 736
Stoke Gas Undertaking—Dover Gas Company—Halifax Gas-Works Extensions—Artesian Boring at Bungay—Proposed Extension of the Meltham Gas-Works 737
Bristol Public Lighting—British Coal at Genoa—Land for Gas-Works Extensions at Chester—Bolton and its Proposed New Water Supply—The Morcambe District Council and their Gas Undertaking—The Gaslight and Coke Company and its Critics—Finances of the St. Helens Corporation . 738
Bognor Gas Company—Tiverton Corporation Gas-Works—Explosions of Gas—Protection of Trade Union Funds—Wentwood Water Scheme of the Newport Corporation—Halesworth Water Supply. 739
Cork Gas Affairs 740

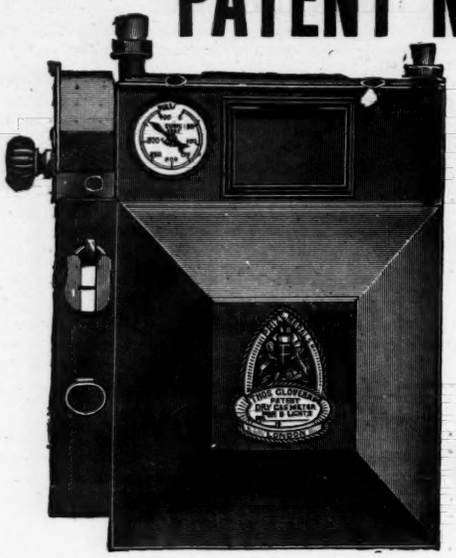
Messrs. HUMPHREYS & GLASGOW

CARBURETTED WATER-GAS PLANT.

38, VICTORIA STREET,
LONDON, S.W.
Telegrams: "EPISTOLARY, LONDON."

UNITED STATES OFFICE:
BANK OF COMMERCE BUILDING,
NEW YORK.

THOMAS GLOVER & CO.'S PATENT NEW IMPROVED PREPAYMENT METER



For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ*.

GUARANTEED FOR FIVE YEARS.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

THOMAS GLOVER & CO., LTD.,

GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN, LONDON, E.C.

Telegraphic Address: "GOTHIC, LONDON." Telephone No. 725, Holborn.

BRISTOL: 28, BATH STREET. *Telegraphic Address:* "GOTHIC." Telephone No. 1005.

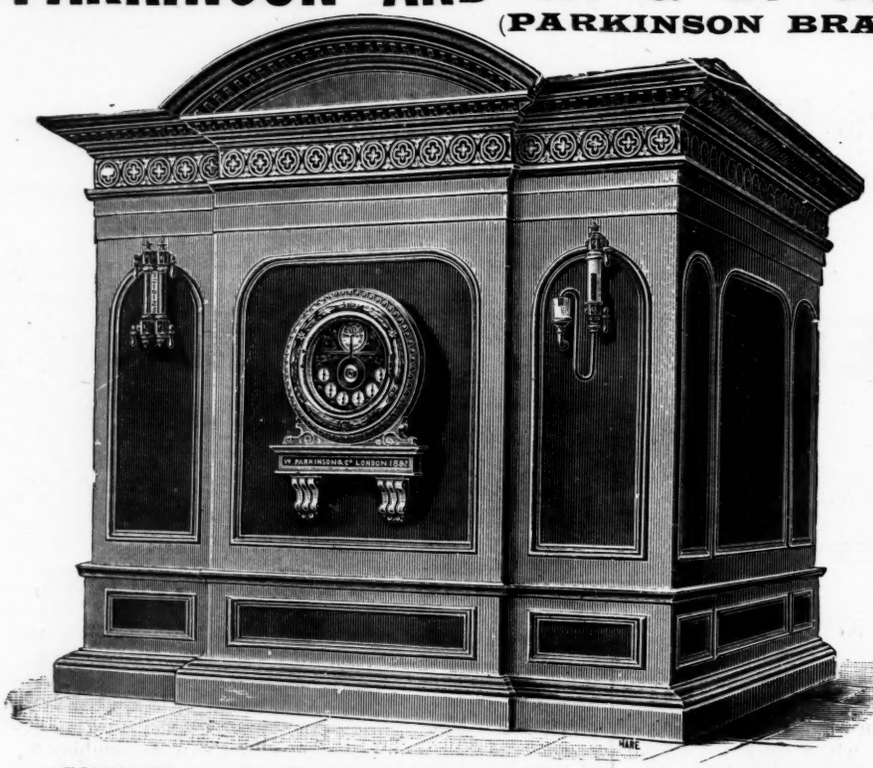
BIRMINGHAM: 1, OOZELLS STREET. *Telegraphic Address:* "GOTHIC."

MANCHESTER: 37, BLACKFRIARS STREET. *Telegraphic Address:* "GOTHIC." Telephone No. 3006.

GLASGOW: 69-71 McALPINE STREET. *Telegraphic Address:* "GASMAIN." Telephone No. 6107.

PARKINSON AND W. & B. COWAN, LTD.

(PARKINSON BRANCH.)



W. PARKINSON & CO. have introduced this design of Station Meter in order to meet the demand for a more ornamental Tank. All joints are planed, the most modern improvements introduced, and the entire Meter is of the strongest and most substantial description.

COTTAGE LANE WORKS, CITY ROAD,

LONDON.

Telegrams: "INDEX," Telephone No. 778 King's Cross.

BELL BARN ROAD WORKS,

BIRMINGHAM.

Telegrams: "GASMETERS." Telephone No. 1101.

[See also Advt. on last White Page.

JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

VOL. LXXVIII., No. 2001.—TUESDAY, SEPTEMBER 17, 1901.

EDITORIAL NOTES.

The Welsbach Patent of 1893.

An Apology.

In our issues of the 27th ult. and the 3rd inst., there were published an Editorial article, a "Communicated Article," and a letter commenting on the Welsbach patent of 1893 and pending litigation thereon. In connection therewith, as will be seen by a brief report appearing in our "Legal "Intelligence" (p. 725) in to-day's issue, an application was made to the High Court of Justice last Wednesday, before the Vacation Judge, for the committal of the Publisher of the "Journal" for Contempt of Court. From the papers delivered with the notice of motion for the committal, we learn that certain of the statements made are without foundation; and these we desire to withdraw without reserve.

In the article it was stated, in effect, that the present policy of the Welsbach Company appears to be to deliberately refrain from attacking large makers of incandescent mantles who are able to defend themselves, but instead to prosecute smaller makers who cannot defend themselves. From the information now at our disposal, we believe that this statement is entirely without foundation. We further stated that the United Chemical Works—makers of the "Guaranty" or "Dura" mantles—were not being prosecuted. We now learn that this statement was quite incorrect. It appears that an action against the United Chemical Works (who are the makers of the "Guaranty" or "Dura" mantles) was commenced last October, and was ready for trial in April; but an application was made early in May to adjourn the trial, at the instance of the United Chemical Works, in order, it is stated, that they might endeavour to obtain further evidence. The Welsbach Company also assure us that they have brought actions against *all* makers who have manufactured according to the 1893 patent.

Both in the Editorial and the "Communicated Article," it was suggested that what is claimed under the 1893 patent was public property in 1891, and that a paper by Mr. W. Mackean, F.C.S., contained information as to the manufacture of the mantles, with the percentages of the rare metals giving the best results. Our correspondent also stated that at about the same time Mr. Julius Moeller published a circular from the Welsbach Company's offices practically giving the same information. We are now satisfied that we were under a total misapprehension as to this matter. The 1893 patent claims a mantle made of pure thorium with a small percentage of cerium; and we now learn that no such mantle is disclosed either in Mr. Mackean's paper or in Mr. Moeller's circular.

Under these circumstances, we express our regret for the publication of the statements to which we have referred, and for our comments on the pending litigation which were based on these statements.

Professor Rücker's British Association Address.

The address of the President of the British Association, Professor Arthur Rücker, completely satisfies the high expectations that had been formed respecting it, not only in these columns but elsewhere. In style, it is a blend of somewhat studied eloquence with a severely accurate re-statement in plain English of the freshest acquisitions of workers in pure science the world over. Indeed, in the beginning the orator seems to have modelled himself on the great prose-poet to whom the world is indebted for the work of Deuteronomy; but he soon came to close quarters with his own proper topic, which was nothing less than an examination of the hypotheses and assumptions upon which modern physical science is built, in order to ascertain whether the foundations of the mighty structure have been so well and truly laid that they may be trusted to sustain all that can be fairly laid upon them. This is a big subject, requiring for adequate treatment not only a complete knowledge of all the assumptions in question, and of all the working hypotheses that have ever been suggested for the explanation and co-ordination of the known phenomena of the natural world, but also a sure grip of all the criticisms that have been, more or less successfully, directed against them. It is not saying too much of Professor Rücker that he did not fail under this tremendous requirement. On the contrary, he dealt with all these things with the greatest apparent ease, bowing on the one hand to this eminent hypothesis-framer, and on the other greeting deferentially a celebrated critic. Meanwhile, he went steadily on, until before our eyes lies unrolled the chart of scientific conquest. The conceptions which have guided workers in physical science during the past century are the theories of the existence of atoms, of the mechanical nature of heat, and of the existence of the cosmic ether.

One of the most striking failures of the science of the immediate past and of the present is the breakdown of all attempts to establish a complete proof of any of these hypotheses, and also of every suggestion of a means of connecting them with the independent phenomena of life. Professor Rücker is not troubled overmuch by these shortcomings, boldly taking up the position that, in the task of reducing phenomena to some intelligible order, and helping to explain them, an essentially false hypothesis may be useful in its way. The difference between the old didactic teaching as to the divergence between the material and the spiritual, of all the ancient physicians' imaginings about "concoction "of the humours," and of the other guesses that constituted the physics of the old schools, and the assumptions of modern science, is that the latter are not put forward as being anything more than they are. Criticism of them is disarmed when it is admitted that they do not go below the surface, do not propose anything about the constitution of material bodies, and merely describes their behaviour "by means of "laws of Nature expressed by equations," which at best are in all probability only approximately correct. Here Professor Rücker first expresses his willingness to part company, on conditions, with the atomic theory as a guide to the arena of inanimate Nature. If the atomic theory is to be regarded as an abstract equivalent for a child's box of bricks, in enabling us to build up symmetrical representations of material substances—and it is safe to say that such is the effect of the theory upon the minds of most people who have ever read about "atoms" and "molecules"—then the impossibility of binding Nature to our arithmetic should warn us that we must not set too much store by such attempts "to give an unnatural precision to ideas which are, "and must be, vague."

Yet the ideas of atoms and molecules are all well enough in their way. They correspond to certain classifications which we are able to make, quite accurately, of properties and components of matter that do not appeal to the senses—as in the analysis of the atmosphere, for example. We may know no more of the ultimate nature of carbonic acid than we can tell off-hand of the air we breathe. But it is recognized that an investigation into the proximate constitution of things may be useful and successful, even if their ultimate nature is beyond our ken. We can, indeed, chase the elusive "element" through several embodiments until we get it at last, naked and unashamed, in the form of what we call pure oxygen, argon, or something else. What then? Is analysis (research) to stop here? That is the question. Here, however, we must be content to leave the reader of these lines in the hands of Professor Rücker himself. It is as impossible to condense his argument as it is to split up an atom, according to the atomic theory; and equally beyond our ability to paraphrase his lucid statements. Suffice it to say that, after showing his own openmindedness in the premises, Professor Rücker leaves our old friend the atom pretty much where it was before—in the capacity of a coarse-grained particle of matter, not adherent to its neighbours; and thereby competent to explain the most salient phenomena of heat and expansion. He also gives a very good testimonial to the ether. Lastly, when speaking of the failure already mentioned—the lack of correspondence between certain vital and physical phenomena—Professor Rücker has

declared it to be a mistake to treat physical theories as though they are parts of a scheme which fails if it leaves anything unexplained. Hypotheses and assumptions may be good so far as they can be reasonably made to go; but we are neither pledged to discredit them utterly if they fail at certain points, nor to press them to logical conclusions that are repugnant to common sense. With all their shortcomings and irreconcileabilities, Professor Rücker certifies the atomic theory of matter, and the theory of the ether, to account for vibrations that cannot be referred to the movement of matter, as "well and truly laid," and therefore worthy of being trusted. Even when we learn what atoms are, and what the ether is, the recognized theories of them will probably hold good.

Professor Lewes's New Experiments in Gas Manufacture.

One of the most valuable fruits of the function at Glasgow, so fully reported in last week's "Journal," was the publication of the first results of the practical-scale trial of Professor V. B. Lewes's process for utilizing water gas to assist in the manufacture of coal gas by the ordinary method. It is, of course, superfluous to insist upon Professor Lewes's claim to be heard with respect whenever he chooses to speak upon a matter of gas chemistry. When he began to specialize in gas, Professor Lewes started with all the enormous advantage of a complete command of the resources of the modern chemical analyst. These have been almost entirely created—at least, they have been enormously increased and improved—since the days of the inventors of the older order in gas, whose critic and instructor was Dr. Letheby. Then, almost anything was regarded (even by men of much technical experience) as possible in the way of increasing the yield of gas, or improving its illuminating power, by means which can only be properly characterized as "hanky-panky." A previously sane and self-controlled gas manager would conceive the happy thought of turning a retort upside down, or adding some "chemical" to the charge at a nominal cost; and forthwith he fell a victim to the delusion that he was thereby getting double value from his coal. This effect was entirely due to ignorance of that science which is merely measurement. Simple as the proposition sounds, it has cost vast sums of money, and many broken lives, to establish the truth that even in gas manufacture it is impossible to get something for nothing.

Professor Lewes then brought into the gas industry the thorough mastery of a science which is competent to check all chemical processes at every stage, and thereby to keep progress from wandering out of the right path. This accomplishment is invaluable, and indispensable; but it does not necessarily help progression. Chemistry, as understood in colleges and schools, may be very barren. A chemist with half-a-dozen letters after his name may be of the same quality as the banker's clerk who keeps the inventor's pass-book. Something more than acquaintance with the art of book-keeping in the chemical elements is required in order to render the chemist also a producer on his own account; and it is his possession of this motive power that endows Professor Lewes with his most valid credential in the estimation of practical gas makers. He is as fertile in suggestion as he is accurate in investigation—which is to say much.

In the present case, Professor Lewes has taken up, with the assistance of his unique individual advantages, and the benefit of the available gas engineering accomplishment at the disposal of the Crystal Palace District Gas Company, an idea which is at least half-a-century old, and has done more towards realizing it than any previous worker can claim. It is not for us to distinguish between the ancient and the modern in this edifice; but it is not disputable that the notion of distilling coal in a stream of gas from some other source is old. It has been proposed by many persons, with various purposes to serve; and the combination of coal-carbonizing retorts with water-gas generators has been patented in the United States several times over. Professor Lewes states in his paper that he was led to suggest this combination by his studies of the analytical and synthetical actions of heat, as the radiant heat of the inside of a retort, upon the gaseous hydrocarbons travelling through it, and of the effect of dilution in checking such actions. Hence his suggestion that if a stream of water gas could be passed through the crown of a retort during the process of carbonization, the dilution and hurrying forward of the coal gas thereby secured would prevent undesirable secondary actions taking place. It is a simple thing to contemplate, but by no means so easy to do in a regular, controllable way.

Circumstances occurred to render Mr. George Livesey, the Chairman of the Crystal Palace Gas Company, favourable to the institution at this Company's works of a series of experiments, under the direction of Professor Lewes—in collaboration with Mr. S. Y. Shoubridge, the Engineer to the Company—designed to settle the question quantitatively. The paper describes the arrangements that were made to ascertain, by a straightforward method, what would be the effect of adding "blue" water gas, from the plant on the premises, to the coal gas at determined points. At the very outset of the operations, however, a discovery was made of such an astounding character, and of so much practical gas manufacturing importance, that it overshadows all that was subsequently ascertained. The retorts of the experimental benches were 20 feet long, with the usual ascension-pipes both ends. It did not occur to the Professor as likely that it would make much difference to the experiments whether the gas went out in greater quantity at one end than at the other; but he tried the effect of stopping up one pipe, and found, to his amazement, that the normal make of 10,466 cubic feet per ton was reduced to 8615 cubic feet, while the illuminating power rose from 15·88 to 18·58 candles. This extraordinary tale has a yet more remarkable sequel. It was decided to continue the experiments this summer, with the difference of substituting a new bench of inclined retorts for the old horizontal "through" retorts previously employed. And, broadly speaking, the inclined retorts did better in all respects than horizontals; while the use of a single ascension-pipe did not apparently affect the net result.

It will appear to most gas manufacturers that there is in this statement alone much matter for reflection. It seems, to begin with, to contradict the *a priori* assumption upon which Professor Lewes based his original suggestion. For, he says, he thought the "decompositions and interactions "taking place in the upper part of the retort among the "hydrocarbons" were detrimental to the value of the gaseous product. He laid it down that the farther the gas went through the retort, the worse it became, "until it had hardly "any illuminating value;" whereas the long travel of gas through the Sydenham horizontal retorts, with their single ascension-pipe, actually enriched it at the expense of the quantity! Surely, there is a contradiction here? We notice that Mr. G. R. Love, of Guildford, stated that his experience was wholly different, and cannot help thinking that there is an explanation missing hereabouts.

Professor Lewes has done good service to the British gas industry by his work on these lines, and his candid disclosure of the results, for whatever they may be worth. Much more, however, as he confesses, remains to be done, besides the clearing up of the initial fogginess in connection with the ascension-pipe effect. The next point posed is that it appears to be advantageous to add 40 per cent. of blue water gas to the make of coal gas nascent in the retort, which will yield a gas testing (under the Sydenham conditions) 14½ candles, and possessing a calorific value of about 500 British thermal units. The purified gas will then have in it about 14 per cent. of carbon monoxide, which is no real objection, provided that the mixture is of fairly constant proportions. "There's the rub," in these high mixtures of water gas and coal gas. It is not the slightly higher content of carbon monoxide that is objectionable, for nobody knows of it; but it is the varying length of flame and of the requirement of air for the satisfactory working of an atmospheric burner in the case of these shifting mixtures, which give trouble.

There is an apparent omission in that part of Professor Lewes's paper which makes the last complete paragraph of the second column of our report on p. 625. It is written there, that a gas manager who has been supplying 16-candle gas can turn out between 14,000 and 15,000 cubic feet of 14·5-candle gas "per ton," by the method indicated. It should have been stated, "per ton *of coal carbonized* only," to be quite safe from any misapprehension. Of course, the author did not mean to exclude the weight of the coal that went to make the coke that made his 40 per cent. of water gas; but he does not mention it. Neither did he stipulate that the 16-candle gas must be all pure coal gas to start with, not carburetted. These are not insignificant criticisms, as one cannot be too particular in drafting claims.

When all is said by way of criticism, or even of detraction of the results described, this paper remains a highly valuable contribution to the available stock of information relating to the chief gas engineering problem of the day—namely, how to make the cheapest 500-unit gas. There is very clearly a

certain limitation put upon the author's prescription, in the fact that he dealt only with what might be called the upper middle-class gas, of 16-candle power. What is a maker of 14 or 14½ candle coal gas—the gas for the million—straight from the coal, to do? Professor Lewes himself apologizes for his present inability to convey a message of comfort to this deserving person. We fully believe, however, that if the commixture of the gases at their highest temperatures, as advocated in the concluding part of the paper, could be effected, there would be more than one benefit from the improvement. Meanwhile, Professor Lewes is to be heartily thanked for his paper.

The Outlook in the Coal and Iron Trades.

THE attention of the public has been drawn to the question of coal supplies during the past week by numerous paragraphs in the Daily Press, relating to a rumoured amalgamation of the various collieries of South Wales—"a scheme, "the extent and importance of which," we are solemnly told, "will not be second to the vast steel enterprise engineered "by that prince of American financiers, Mr. Pierpont "Morgan." The capitalization, we are then told, will be enormous—"the figure of £20,000,000 will not be an exag- "gerative one." What a pity it is our journalistic shriekers do not think a little before they write such rubbish as this. "Not second" to the American Steel Trust, presumably means equal to, or greater than, that combination, which, the same papers were telling us a little while since, has a total capital just ten times that mentioned as the probable amount represented by the South Wales undertakings. Mr. Carnegie's individual share of the purchase money was stated to be £80,000,000.

If this amalgamation is brought about—and perhaps a misprint in a contemporary, which speaks of the *nogotiations*, is prophetic—what effect will it probably have upon the coal market generally? Very little, we think. The Welsh trade is largely export, except for the supply of coal to the Navy; and best Cardiff coal is of such a quality as to have a practical monopoly of its markets. Moreover, the combination is only designed to prevent the underselling of one Welsh colliery by another; and it will be impossible for the Trust to maintain the price of the lower grades of steam and bituminous coals at anything materially above the ordinary market rates, while they will undoubtedly take care not to overreach themselves in regard to the best qualities. The Northumberland steam-coal market might be occasionally stiffened, if the Welsh Trust kept their figure too high; but, speaking generally, we do not think that gas-coal buyers need fear much from the rumoured amalgamation.

At present, the Northumberland and Durham markets are decidedly active, though not perhaps so noticeably as in the past two or three weeks. The output is undoubtedly below the average; the North has secured more than its usual share of orders this year (at the expense of both Yorkshire and Scotland); and the export trade shows no material abatement. The figures for August record a falling-off from the corresponding figures for 1900 of about 4 per cent. in the foreign sales of coal (4,003,009 tons, against 4,173,499 tons), thus making a total decrease for the eight months of 1,137,248 tons. But the shipments of bunkers continue to show a remarkable increase; the figures for the month being 1,200,800 tons, compared with 966,736 tons in August, 1900, while the totals for the first eight months of the year show an increase of no less than 1,208,619 tons, or 16 per cent. The tonnage of shipping entered and cleared during that period shows practically no increase.

So far as the home trade is concerned, there is nothing to warrant any fear as to a prolonged hardening of the coal market. The revival in the iron trade, while enough to give some impetus to the coke market, is not, nor is it likely to become, sufficiently marked to check seriously the downward course of coal prices. Exports continue to show a heavy falling-off in foreign sales; the month's shipments of iron and steel being 232,423 tons, as compared with 278,097 tons in 1900, and 290,212 tons in 1899. The totals for the eight months read: 1899, 2,346,661 tons; 1900, 2,538,213 tons; 1901, 1,941,739 tons—a very remarkable decline in trade. The exports of pig-iron have been very little more than half those of 1900; and the condition of business on the Continent is not such as to give rise to any expectation of improvement in our foreign trade at present.

Such a decline as that shown by the foregoing figures will take a lot of making up in home orders; and it is worth noting that the revival in the iron and steel markets, slight as it is, has been sufficient to lead one of the principal railway companies to postpone a large order for the construction of locomotives. We have no belief in the revival being anything more than the inevitable rebound from the very sharp decline that followed the "boom." So many orders were kept back as soon as the market showed signs of a break last year, and for so long, that when the fall in prices had reached such a figure that manufacturers preferred closing works to making further reductions, the pent-up business was let loose with something of a rush. When that has spent itself, prices will again move downward; for, until bottom has been reached, and the accumulation of capital has become unwieldy, new enterprises of magnitude will not be entered upon freely. It is, moreover, obvious that, with trade so depressed in Germany and Belgium, any prolonged maintenance of high prices for iron and steel in this country would mean a large influx of foreign supplies. In short, we see no reason whatever to fear a return of high prices for iron and coal for a long time to come—labour troubles always excepted.

Wages and Hours of Labour.

WE publish elsewhere a summary of the most interesting of the particulars contained in the Board of Trade report on changes in rates of wages and hours of labour in 1900. The gist of the report is that wages showed a general tendency upward during last year, not striking in degree or extent so far as the general body of workers was concerned, but very great and widespread in the coal mining industry; that the increases granted were, in regard to 95 per cent., obtained by peaceful means; and that, apart from the introduction of the eight hours' day into the Lanarkshire coalfields, no considerable number of workmen had their hours of labour reduced. The increase in the rates of wages to the coal miners last year was enormous, amounting, on the average, to nearly 5s. per head per week, and to over 8s. per week compared with 1897. These higher wages, it is to be noted, were granted, not because the market value of labour rose correspondingly, nor because the men had by their greater exertions increased the profits of their employers, but simply because conditions outside the control of either owners or miners had brought about an inflation of the coal market, through the demand exceeding the supply. The result of the men having received this unearned increment of wages is that, now that the excess of demand over supply has been destroyed by the natural course of events, the miners are endeavouring to maintain that state of the market by reducing the supply, and so stave off the inevitable fall in wages.

So far as Scotland is concerned, the award of Sheriff Jameson—the neutral Chairman accepted by both parties on the Conciliation Board—brings wages down to the level at which they stood before the "boom" began. The rate now fixed until the end of October is 50 per cent. above the 1888 standard, equal to 6s. per day, as compared with the high-water mark of 100 per cent. (8s. per day) enjoyed by the miners last year. The minimum that can be fixed by the Conciliation Board is 37½ per cent. above the standard. At the rates now settled, the output will probably tend to improve. In Northumberland and Durham, wages have been reduced very considerably, though they are still well above those current at the beginning of 1900; and complaints of reduced output are very general in those counties—complaints that find confirmation in the condition of the northern markets. In South Wales, high rates are still being paid; while in the Federated districts, wages are higher now than when coal was dearest. Until wages have come down to the normal level, the output of coal is certain to be below the average. The fear is as to whether this adjustment will be a peaceful one; for it must not be forgotten that the miners in the Federated districts constitute one of the strongest Trade Unions in the country, and that no automatic machinery for the regulation of wages exists there as in South Wales and the northern counties. The whole principle of adjusting miners' wages to the market price of coal, instead of by the ordinary methods of bargaining, appears to us open to very serious objection.

Apart from the enormous rise in the earnings of the miners, there are other points of considerable interest in the Board of Trade report. Gas workers to the number of 6355 were granted higher wages; the great majority being those employed in the northern and midland counties, where, owing mainly to the activity in the coal, iron, and metal trades generally, and in a small degree to the war, labour was in somewhat unusual demand last year. The number

of gas workers employed by private undertakings granted higher rates of pay, exceeded that in any of the preceding eight years, except 1898. Only 223 employees at gas-works had their hours of labour reduced in 1900. The movement in favour of the eight hours, or any other reduced, working day has, in fact, made very slow progress—the total effect of all the changes known to the Board of Trade during the past eight years being only equal to ten minutes per week per head of the total industrial population. But while admitting that reductions in the hours of labour do not necessarily entail reduced output, it may be well if we point out that, assuming the productiveness of each man to have been reduced proportionately to the shortening of the hours, ten minutes per week per head of the industrial population represents the annual labour of about 25,000 men (working fifty hours per week for fifty weeks) which may be valued at over £1,500,000. The result of adding such a sum to the cost of our aggregate annual production of raw material and manufactured goods would be, of course, a tendency to a reduction in the volume of the output—a reduction which might, in the end, lead to a reduction in the number of workmen employed far in excess of the additional labour originally absorbed in consequence of the lessened output per workman. This fact—that our position in the commercial world, the volume of our trade, and, consequently, the amount of employment to be obtained in this country, depend to a large extent upon our capacity to produce and manufacture cheaply—needs specially to be emphasized at a time when the Trade Union Congress are passing resolutions, such as that proposed by a gas workers' delegate recently, "that, seeing that an "eight-hour working day . . . . . *will lessen the number* "*of unemployed* . . . . the time has arrived when the "hours of labour should be limited to eight per day in all "trades and occupations in the United Kingdom."

We have left ourselves little space in which to speak of the continued tendency for the wages of the employees of public authorities to be increased, and their hours of labour to be reduced, or of the steady rise in the rates of pay current in the agricultural districts, obviously a consequence of the drifting of labour from country to town. Upon the first question we have had something to say elsewhere, so will only now remark that the number of public employees receiving increases of wages last year was 50 per cent. higher than in any of the preceding seven years.

Further Consequences of the Taff Vale Railway Case.

The fresh advertisement given to the judgment of the House of Lords in the Taff Railway Company's case by the discussion of the subject at the Trade Union Congress, has had the natural effect of evoking some further expressions of opinion on the general question of the status and consequential liabilities of these organizations. And, last of all, the announcement that Mr. Edmund Browne, "L.C.C.," the standing Counsel to the Parliamentary Committee of the Congress, has gone on the Continent "to ascertain how far "the funds of the Unions could be protected in the event of "their being invested in foreign securities," is well calculated to sustain public interest in the matter. Meanwhile, it is reported that both at Limerick and Blackburn promising cases for testing the law of picketing, as recommended by Mr. Browne to the Trade Union Congress, are in course of development. The idea of placing the Trade Union funds beyond the reach of the law of the land whence they are derived, to which they are declared to be subject, may be "smart," but is it really fair play? Essentially, it is of a piece with the kind of smuggling in which so many modern rich men engage—the attempt to evade the duties and the obligations that attach to the possession of capital, while enjoying all the advantages of wealth. Politically, it is a desperate move to enable the Trade Unions to continue to exercise collective power without thereby incurring the risk of having to pay for its wrongful exercise. Actually, it is only a piece of "bounce," without the smallest practical meaning. The fact that such notions should be entertained for an instant by the wirepullers of Trade Unionism, ought to indicate to the outer world something of the true character of this movement. One wonders what Mr. Lockie, who dreams of a "union of hearts" between associated employers and Trade Unions, thinks of this proposal.

Among the ablest of the numerous newspaper commentaries on the Taff Vale Railway case that has come under our notice, appeared in the "Liverpool Post" of the 13th inst. The writer goes a little way—a very little way—into the law of torts, as distinguished from the law of contracts, and succeeds in conveying the impression that the mixture of the two in the case of the Trade Unions is such a muddle that the only way to disentangle them is to give to these bodies a corporate existence. This, be it noted, is what nobody who professed to have the interest of Trade Unionism at heart has favoured; for the reason that incorporation would place all the funds of a Trade Union at the mercy of civil process, taken in the name of the secretary. Besides, an incorporated society can only discharge the duties enumerated in their charter or memorandum of association; and these purposes must be of a lawful nature. Raising wages and keeping up wages scarcely come, one would think, into this general classification.

The liberty of action hitherto enjoyed by Trade Unions was intentionally entrusted to them in order that their funds might not be held liable for every questionable action committed by an official, probably little learned in the civil law. It has been abused, however, to cover proceedings which strike at the very foundations of the liberty of the subject—a licence which, as the House of Lords says, it could never have been the intention of the Legislature to bestow. Without a degree of freedom from civil responsibility for the acts of the executive management, no mutual association, such as a club, would ever be formed in this country. No man would commit himself to a rigidly binding code entailing unlimited responsibility, as the condition upon which the limited benefits of association were to be enjoyed. But a Trade Union has no analogy with a club. Its main purposes are such as no mere club could embrace; and it is only fair that its pecuniary responsibility, to the extent of its realizable assets, should be complete for the wrongful acts of its legally-appointed representatives whenever they are done in pursuance of such objects.

Waverley Association Meeting.

One can correctly describe as "another useful meeting" the gathering of the Waverley Association of Gas Managers which was held at Musselburgh on Thursday last. The absence of formality in the proceedings gives the feeling that the members get nearer to each other than they do where the constitution of the assembly is on more stiff lines. Certain it is that when once the manager of a gas-works takes an interest in the affairs of the Waverley Association, no matter how far he may wander from the district, he never loses his allegiance to the parent of all Associations, as Mr. Yuill on this occasion termed it. This may, to some extent, be due to sentiment; but a perusal of the proceedings at the meeting will satisfy most readers that, for the managers of moderate-sized works, there were sentiments uttered which are not visionary but which have the pleasing habit of becoming hard—either in fact or cash. The President (Mr. A. C. Young, of Kelso) was unable, from a most regrettable cause, to be present; but he had prepared a paper on his experience in the working of a simple and cheap form of regenerator furnace, which he forwarded, and which Mr. H. O'Connor, of Edinburgh, read to the meeting. Mr. Young is to be complimented in that he laid only one subject before the meeting; and if further compliment be given him, it is that he selected a subject that was of some interest to all his hearers. The results which have been obtained by those who have worked regenerative settings (so amply communicated to the meeting) must set men a-thinking upon the question. Mr. Young has clearly demonstrated—and others tell of experiences similar to his—that it is possible to erect a simple form of regenerator, which can be put down at a cost so small that it is a source of profit to the undertaking. This was sufficient to make the meeting a success; but there was, in addition, the charm of again sitting under the chairmanship of that sturdy veteran, Mr. Alex. Bell, of Dalkeith, and the pleasure derived from the courteous reception of the members by Mr. Herring on their visit to the Granton Gas-Works—not forgetting, too, the "liberal education" which the visit was to them.

Mr. E. W. Pim, the Chairman of the Belfast and District Water-Works Commissioners, has been presented by the members and officials with a silver tray and an illuminated address in album form, in recognition of his valuable services to the Trust. For fifteen years Mr. Pim has been a commissioner, and three years he has occupied the chair, during which his zealous work and devotedness to the interests of the Trust have gained for him the highest respect of all with whom he is associated.

THE PRODUCTION OF ILLUMINATING GAS FROM COKE-OVENS.

By F. Schniewind, Ph.D., of New York.

[A Paper read before the Gas Section of the Engineering Congress at Glasgow.]

The object of this paper is to describe the progress which has been made in the United States and Canada in recovering illuminating gas from bye-product coke-ovens. A clear account of this cannot be given without repeating some of the previous statements published.*

Before entering upon the subject, I cannot resist the temptation of discussing its bearing upon the vexed smoke problem of large cities.

The Fuel Supply of Large Cities.

The question of the fuel supply of large cities is of the greatest importance. Notwithstanding this fact, its study has been neglected in a distressing manner. We still see the large manufacturing cities in Great Britain, as well as in the United States and other countries, darkened and begrimed by clouds of smoke and soot resulting from the use of bituminous coal. The annual expenditure for the maintenance of buildings, &c., is increased, not to mention the deleterious effect on the health of the people.

The subject has been discussed by Mr. George Beilby in his Presidential Address before the Society of Chemical Industry.† He gives the following table:—

Table I.—*Consumption of Coal in the United Kingdom in* 1898.

		Long Tons.
1.—*Coal for the Generation of Power in Industries—*		
Railways	10,000,000 to 12,000,000	
Coasting steamers	6,000,000 ,, 8,000,000	
Mines	10,000,000 ,, 11,000,000	
Factories	38,000,000 ,, 40,000,000	
Total		76,000,000
2.—*Coal for the Generation of Heat in Industries—*		
Blast-furnaces	16,000,000 to 18,000,000	
Steel and malleable iron works	10,000,000 ,, 12,000,000	
Other metallurgical works	1,000,000 ,, 2,000,000	
Chemical works, potteries, and glass works	4,000,000 ,, 6,000,000	
Gas-works	.. 13,000,000	
Total		46,000,000
3.—*Coal for Domestic Purposes*		35,000,000
Total consumption, long tons.		157,000,000

Of this amount of bituminous coal, only a very small percentage is subjected to dry distillation, which converts it into smokeless coke (see Table II.); the remainder is almost entirely burned, directly under conditions which are favourable to the production of smoke.

Table II.—*Coal Subjected to Dry Distillation in the United Kingdom in* 1898.

	Long Tons.
Gas-works	13,000,000
Blast-furnaces	2,000,000
Bye-product coke-ovens	1,250,000
Total, long tons.	16,250,000

This figure does not include the coal coked in beehive ovens without the recovery of bye-products, which amount is approximately 12,500,000 long tons.

Mr. Beilby suggests two solutions of the smoke problem: (1) The use of improved appliances for the combustion of the raw coal; and (2) the transformation of the raw coal into smokeless fuel by carbonization or gasification.

We are of opinion that the first method offers only a partial relief, and, furthermore, that it is a wasteful one, because valuable products can be recovered from bituminous coal by dry distillation which are wasted in the direct combustion of raw coal. The second method—*i.e.*, that of the conversion of the raw coal into a smokeless fuel by carbonization—seems to us the most rational and economical solution of the problem. This method has, in the meantime, developed to a very considerable extent in the United States. The United Coke and Gas Company of New York has introduced into the United States bye-product coke-oven systems exploited by Dr. C. Otto and Co., of Germany—chiefly the Otto-Hoffmann coke-ovens. A large number of these plants have been erected (see Table IV.). In Germany these plants are operated almost entirely for the production of metallurgical coke, while the surplus gas is burned under boilers. A number of the American plants operate in the same way; but several of the later plants are designed for the exclusive manufacture of domestic and railroad coke and illuminating gas.

A very large proportion of the coal consumption, as given in Mr. Beilby's table, is consumed in or near large cities, and we believe this coal should be subjected to a carbonizing process before use. This would supply to the city at once a cheap smokeless fuel suitable for practically all purposes. We will show further on that the use of coke instead of coal would not be coupled with a great expense to the fuel consumer. By the erection of large carbonizing works near or in large cities, the smoke problem would find its ready solution, and at the same time a great saving, from a national-economic point of view, would result from the recovery of the valuable bye-products and gas.

How urgent the demand for smokeless fuels has become is plainly shown by the fuel statistics of some of the larger American cities. In the United States, anthracite is found in a small district in Pennsylvania, while bituminous coal is scattered over almost all the States east of the Mississipi. Notwithstanding the close proximity of the bituminous coal-fields to some of the larger cities, enormous quantities of anthracite are brought to them from a great distance, and consequently at great expense.

Table III.—*Fuel Statistics of Some American Cities for* 1900.

	Bituminous Coal.		Anthracite Coal.	
	Quantity Used. Net Tons.	Price per Net Ton.	Quantity Used. Net Tons.	Price per Net Ton.
		Dollars.		Dollars.
New York*	..	2·50 to 3·50	..	3·50 to 4·00
Philadelphia	1,700,000	2·00 ,, 3·00	3,300,000	4·00 ,, 4·50
Boston	2,050,000	2·50 ,, 3·50	1,950,000	4·00 ,, 5·00
Chicago	7,000,000	2·00 ,, 3·00	1,600,000	5·00 ,, 6·00

* The total amount of bituminous coal and anthracite for domestic consumption and the supply of steamers in New York and adjacent cities, belonging to the port of New York, is estimated at 15,000,000 net tons.

Table III. demonstrates how enormous has the demand for smokeless fuel become, and, furthermore, that a great premium is paid for the smokeless character of a fuel. The prospects are, therefore, encouraging for the erection of carbonizing plants near large cities.

General Description of the Process.

In order to facilitate an understanding of the more detailed account of the process, a general description of the combined coke-oven and gas process is first given, comparing it at the same time with the ordinary gas-retort practice.

Charging Capacity.—The coke-ovens have a charging capacity of 16,000 lbs. of coal, which is all carbonized in 24 hours and less. Ordinary gas-retorts have a charging capacity of only 300 to 400 lbs., which is carbonized in about 4 hours.

Labour Saving.—On account of the increased charge, all the operations around the coke-ovens are performed by machinery, which results in a saving of labour per ton carbonized, as compared with the present coal-gas system.

Quality of Coke.—On account of the larger charges and the peculiar construction of the coke-ovens, a far better coke is produced, as compared with that obtained in ordinary small gas-retorts. The coke-oven yields, if required, a coke which satisfactorily sustains the burden of a modern large size blast furnace. It is consequently of much higher value than gas-works coke. The coke-oven may also produce domestic coke far superior to gas-works coke.

Bye-Products.—The coke-oven, like the ordinary gas-retort, saves tar and ammonia (and eventually several additional bye-products). The coke-oven yields, however, a higher percentage and a better quality of these products than the gas-retort.

Heating Retorts.—The ordinary gas-retort produces the heat necessary for carbonizing the coal by burning a part

* (*a*) Professor Hoffmann's extract from Dr. F. Schniewind's test report on Dominion coal at Glassport (Pa.), "The Production of Illuminating Gas in Bye-Product Coke-Ovens." "Engineering and Mining Journal," Oct. 8 and 15, 1898; "Progressive Age," 1898, p. 575. (*b*) "The Everett Coke Gas Plant." "Progressive Age," Aug. 15 and Sept. 1, 1899; Jan. 1, 1900; "Journal of Gas Lighting," Vol. LXXIV., pp. 1114, 1176; Vol. LXXV., p. 274; Vol. LXXVII., pp. 616, 679, 749, 820. (*c*) "Otto-Hoffmann Coke-Oven Practice." "American Gas Journal," Vol. LXXVII., p. 444. (*d*) "Bye-Product Coke in the United States." "Iron Age," Vol. LXXVIII., p. 14.

† "Journal of the Society of Chemical Industry," Vol. XVIII., p. 643; "Journal of Gas Lighting," Vol. LXXIV., p. 175.

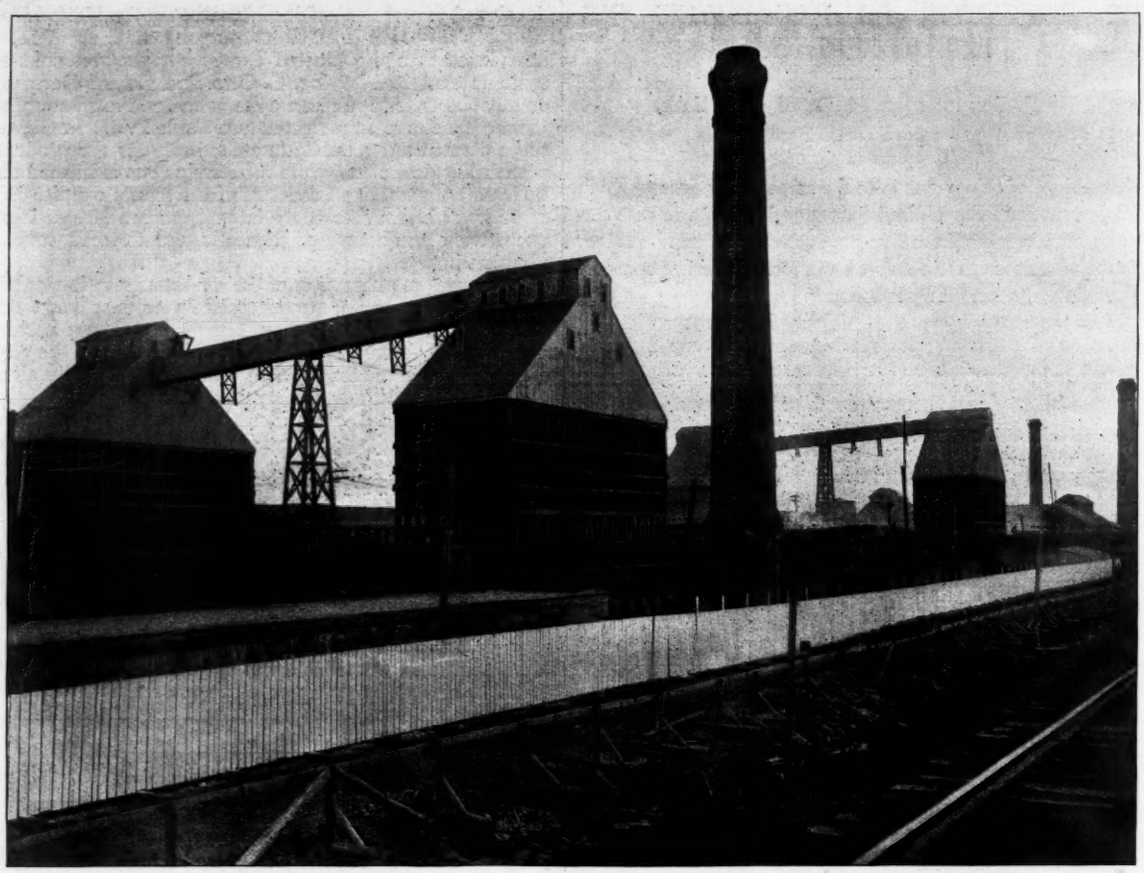


FIG. 1.—VIEW OF THE EVERETT COKE-OVENS.

of the resulting coke under the benches. In the coke-oven process, all the coke is saved, while a part of the resulting gas is burned under the ovens.

Separation of Gases.—A ton of coking coal produces a total of about 9000 cubic feet of gas, of which 5000 cubic feet are required for heating the ovens, while the remaining 4000 cubic feet are available surplus. Instead of taking these 4000 cubic feet from the average gas mixture, the gas is separated into two fractions—viz., the first, or rich fraction, 4000 cubic feet, which is sent to the city; the second, or poor fraction, 5000 cubic feet, which is used for heating the ovens. The first fraction is of much higher candle power than the second, and can be used directly without any further enriching.

Greater Variety of Coals Available.—As only the richer part of the gas is used, almost any bituminous coal can be charged. Even from the poorest kind of coal, a gas of higher candle power is obtained by coke-ovens than from the richest gas coals by ordinary retorts. Thus, in the selection of coal, we are governed chiefly by the character of the coke desired.

Fluctuation of Gas Consumption.—The process, as described, gives the same amount of gas every day in the year. In order to meet the fluctuations of the demand, an auxiliary producer, or water-gas plant, is provided. This furnishes a cheap fuel gas from the cheapest coal or refuse coke, which can be used for heating the ovens. More coke-oven gas becomes available thereby.

Transferring Illuminants.—By thus increasing the gas output of the plant, the candle power is reduced, because the gas becomes poorer the further the carbonizing process progresses. In order to equalize the candle power, the poor gas is washed with tar oil, which robs it of its vaporous illuminants (the benzol, &c.). The tar oil on subsequent distillation gives up these illuminants, and is then used for another absorption, while the illuminants are directly added in vaporous form to the rich gas until the desired candle power is obtained. In summer time, only a small part of the benzol from the poor gas is needed to produce a gas of, say, 20-candle power. The remainder is therefore condensed to a liquid state, and stored for use during the increased demand in winter.

Independence from Enriching Materials.—By this process, a gas of high illuminating value is manufactured from coking coal alone. No oil or other enriching material is required.

PLANTS BUILT BY THE UNITED COKE AND GAS COMPANY IN THE UNITED STATES AND CANADA.

Since the autumn of 1898, the large carbonizing plant of the New England Gas and Coke Company has been in operation at Everett, near Boston; and the readiness with which the coke is disposed of, for domestic and locomotive fuel, is conclusive proof of the above statements. We shall refer to this plant frequently; and the picture of the plant before you may therefore be of interest.* This plant of 400 Otto-Hoffmann ovens was erected by the United Coke and Gas Company. It produces 1400 long tons of coke per day, which is almost entirely used in Boston or vicinity. This amount is disposed of as follows:—

To railroads for locomotive fuel	700 long tons.
To steam plants	350 ,,
For domestic purposes	350 ,,
Total daily output	1400 long tons.

The coke used by the railroads is employed in the suburban passenger traffic with the greatest success. Up to 6,500,000 cubic feet of illuminating gas are sold to various gas-works at Boston. It averages 19-candle power without enriching. Table IV. enumerates the other plants erected by the United Coke and Gas Company, or in course of construction.

From this table, it is seen that four of these plants are producing domestic coke and four illuminating gas. The annual carbonization of all these plants is about four million net tons of coal. There can be no doubt that, on account of the general interest taken in the process in the United States, a very rapid introduction of this bye-product coke-oven system for carbonizing plants near large cities will follow, quite aside from its substitution for the obsolete and

* This view is fig. 1 of the series of diagrams illustrating the paper. It is a large coloured lithograph—not suitable for reproduction in our pages. In its place, we give two photographs of the works; and these, in conjunction with the three views that appeared in the "JOURNAL" for March 5 last, p. 617, will fairly indicate the extent and character of the buildings.—ED. J.G.L.

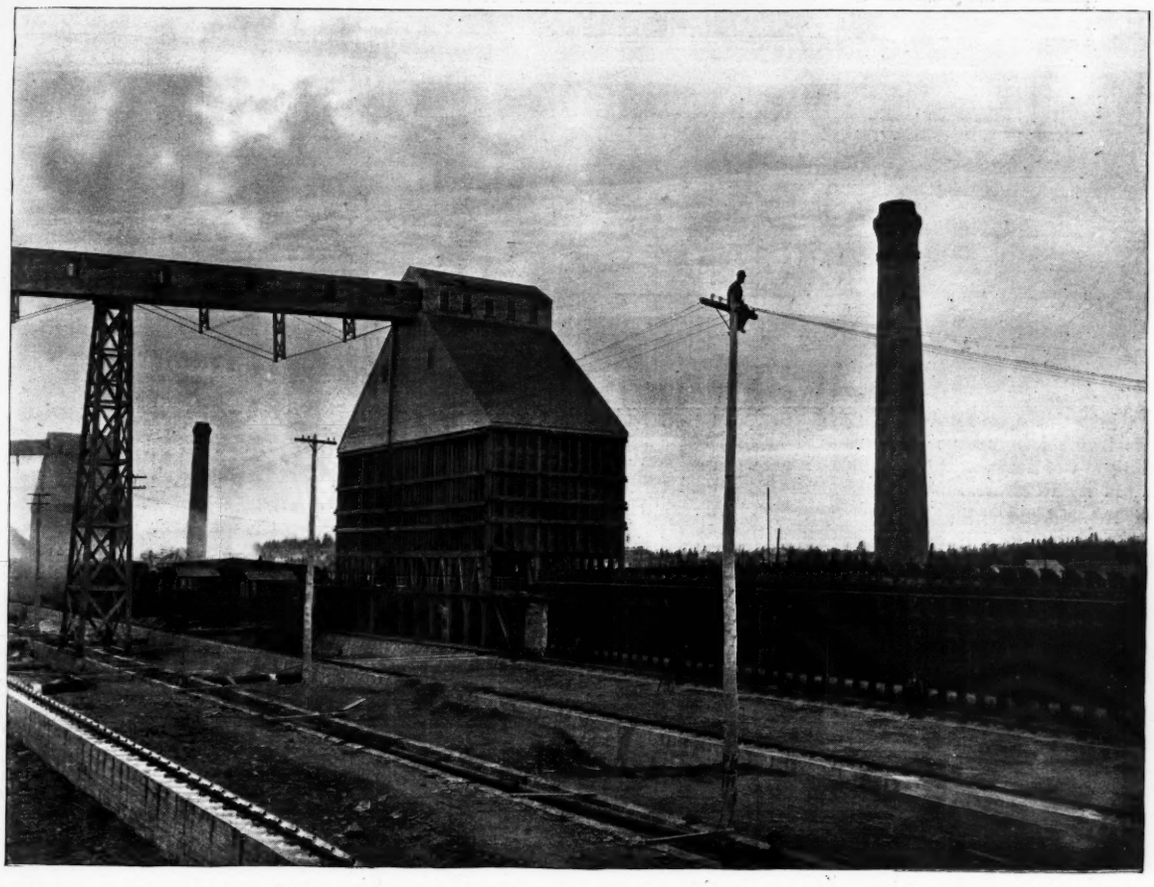


FIG. 1A.—ANOTHER VIEW OF THE EVERETT COKE-OVENS.

wasteful beehive coke-oven, for the manufacture of metallurgical coke.

TABLE IV.—*Bye-Product Coke-Ovens Erected, or in Course of Construction, by the United Coke and Gas Company.*

No.	Owner.	Location.	Erected in	Number of Ovens.	Coke Used for	Gas Used for
1	Cambria Steel Co.	Johnstown, Pa.	1895 & 1898	160	Blast-furnace	Fuel
2	Pittsburg Gas & Coke Co. . .	Glassport, Pa.	1896	120	Blast-furnace & domestic	Fuel
3	New England Gas & Coke Co.	Everett, Mass.	1898	400	Domestic & locomotive	Illuminating
4	Dominion Iron & Steel Co. . .	Sydney, C.B.	1900	400	Blast-furnace	Fuel
5	Hamilton Otto Coke Co. . .	Hamilton, O.	1900	50	Foundry & domestic	Illuminating
6	Lackawanna Iron & Steel Co. .	Lebanon, Pa.	1901	232	Blast-furnace	Fuel
7	Lackawanna Iron & Steel Co. .	Buffalo, N.Y.	1901	564	Blast-furnace	Fuel
8	South Jersey Gas, Electric, & Traction Co. .	Camden, N.J.	1901	100	Foundry & domestic	Illuminating
9	Maryland Steel Co.	Sparrows Point, Md.	1901	200	Blast-furnace	Illum. & fuel
10	Michigan Alkali Co.	Wyandotte, Mich.	1901	15	Burning lime	Fuel
			Total	2241		

DESCRIPTION OF A PLANT OF 100 COKE-OVENS.

In order to adapt the Otto-Hoffmann process, as practised in Germany, to the new requirements, it had to undergo many changes. I will describe a plant consisting of 100 bye-product coke-ovens of the latest type of the United Coke and Gas Company. (See figs. 2 to 5.)

Ovens.—The ovens are arranged in two groups or batteries of fifty ovens each. Each oven 1 is an air-tight retort, consisting of a rectangular chamber, 43 ft. 6 in. long, 17 in. wide, and 6 ft. 6 in. high. The ovens are placed side by side, and are supported on a steel structure, consisting of light ⊦-beams, running the length of the battery, which rest on cross-girders supported by steel columns. (United States patents Nos. 627,595, 644,368, 644,369, 668,225, 673,928. British patents Nos. 13,325 (1899), 3335 (1900), 10,589 (1900), 993 (1901). Further patents pending.)

The construction allows the brickwork to be inspected at all points. The primary object, however, is the uniform distribution of fuel gas to the combustion chambers, for heating the oven-retorts. The retorts are separated by hollow walls, which are divided into ten compartments 2, each compartment containing four, preferably vertical, flues 3. An air-chamber is located directly under the retort 4. Alongside this chamber, and directly under the vertical flues above referred to, are ten combustion chambers 5. The gas-supply to each of the chambers is controlled independently; and a uniform heat is maintained throughout the entire length of the oven. The air for combustion is admitted through opening 6, in the wall between the air and the combustion chambers. The air is heated to 1800° Fahr. by a pair of regenerators 7, placed together under the centre of the battery, and running its entire length. A vertical flue 8 conducts the air from the regenerator to the air-chamber 4 under the oven.

The well-known Siemens principle is used in operating the air-regenerators, with reversals every 30 minutes. The fuel gas is reversed at the same time as the air by means of a suitable valve; but the gas is not regenerated. The gas, uniting with the hot air in five combustion chambers 5, ascends, through the vertical flues 3, to a horizontal flue 9 above, through which it passes and descends through the five chambers in the other end of the oven, thence through the air-chamber 4 and vertical flue connection 8, to the regenerator 7, and through the reversing valves to the stack. The regenerators are built entirely independent of the oven structure, so that their expansion does not affect the oven brickwork.

Coal Handling.—A steel coal storage-bin 12, of a capacity equivalent to about two days' coal consumption, is placed between the batteries. The coal is elevated to the bin from a hopper 13, placed under the coal-receiving track 14, by a belt or other type of conveyor 15. A coal-larry 16, of 8 tons capacity, runs on a track 17 on the top of the batteries and under the coal-bin. The larry consists of a long, narrow bin with eight spouts in the bottom, through which the coal

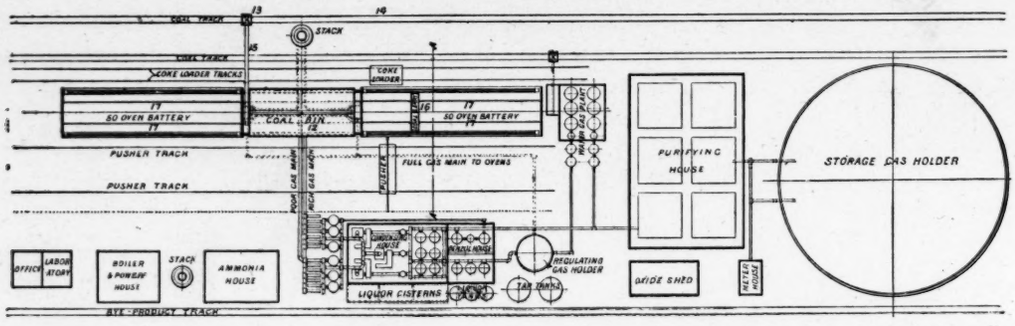


FIG. 2.—GENERAL PLAN OF BYE-PRODUCT COKE-OVEN PLANT FOR THE MANUFACTURE OF ILLUMINATING GAS.

is run into the oven-retort through holes in the top of it, and is levelled by means of a bar worked through a small opening in the doors at the ends of the oven. The larry is operated by an electric motor, and receives its load of coal from the storage-bin, under which it passes. A very dense metallurgical coke can be produced, and the output of an oven largely increased, by compressing the coal into a mould

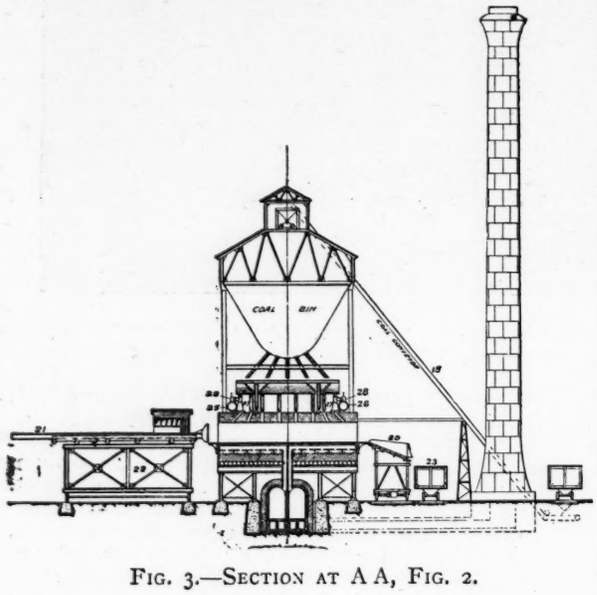


FIG. 3.—SECTION AT A A, FIG. 2.

slightly smaller than the retort, and charging the mass through the oven-door.

Coke Handling.—Upon the completion of the coking-process, the oven-doors are raised, and the mass of 6 tons of coke is pushed upon a movable platform 20, by means of a ram 21. The pushing-ram, as well as the machine 22 on which it is mounted, are operated by electric motors. The coke, after being pushed upon the platform, is quenched and allowed to cool. The platform 20 is then tilted by an electric motor, and the coke slides off into cars 23, which run on a track at the back of the machine.

Gas-Mains.—The gas distilled from the coal during the coking process is conducted to the condensing house by two independent systems of mains 25 and 26. These mains run on top of the battery the entire length—one on each side. Each oven is connected to each main by a vertical pipe 27 and valve 28.

During the first part of the process, the rich gas is taken off through the rich-gas main 25. The valve to this main is then closed, and the balance of the gas is taken off through the poor-gas main 26. When the coking is completed, the valve to the poor-gas main is closed, disconnecting the oven from both mains.

Condensing Plant.—The gas leaving the coke-ovens is divided into two fractions—viz., the first fraction or "rich" gas, which is sent out as illuminating gas, and the second fraction or "poor" gas, which is used for heating the ovens. The cooling of the gas and the removal of tar and ammonia are done in the usual apparatus; hence it is not necessary to discuss it here in detail. Both the rich and poor gases are treated in the same manner. The following is the sequence of the apparatus, as shown in the general sketch of a gas plant for coke-ovens, fig. 6: 1 and 7 are air coolers; 2 and 8 are multitubular water coolers; 3 and 9 are tar extractors; 4 and 10 are exhausters; 5 and 11 are second coolers intended to remove the heat produced by the compression of the gas in the exhausters; and 6 and 12 are ammonia washers.

The rich gas, when freed of tar and ammonia, leaves the condensing plant and passes through pipe 42 into the purifying plant 37, and from there into a large storage gasholder

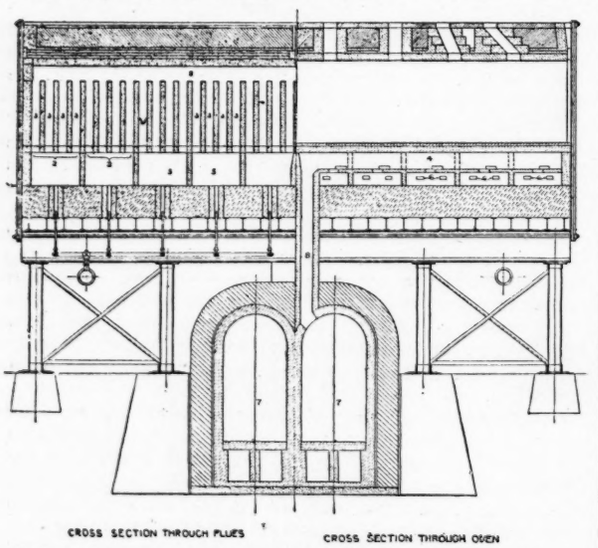


FIG. 4.—DIAGRAM SHOWING SCHNIEWIND TYPE OF OVEN.

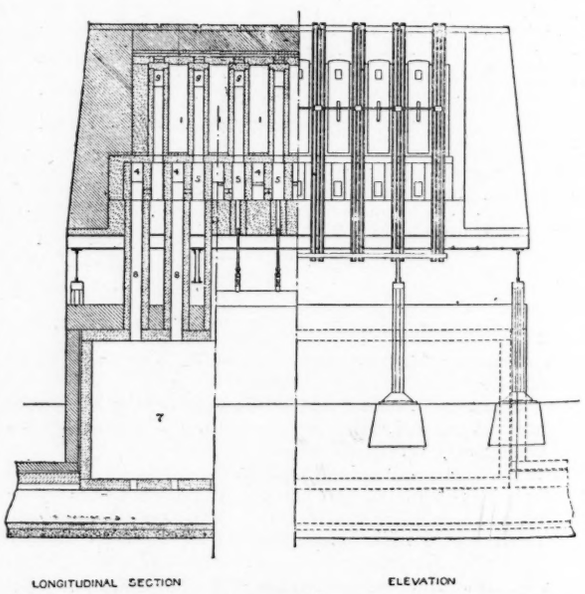


FIG. 5.—DIAGRAM SHOWING SCHNIEWIND TYPE OF OVEN.

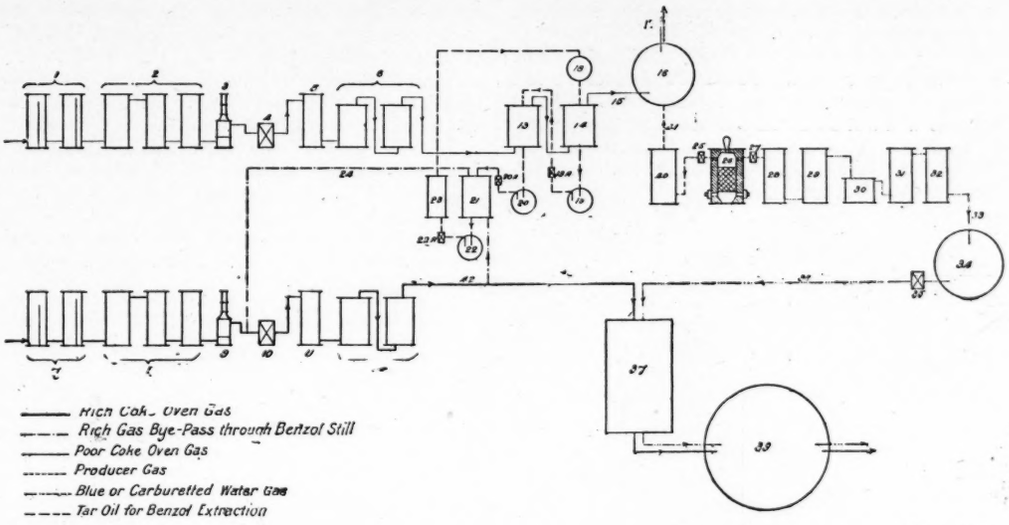

Rich Coke Oven Gas
Rich Gas Bye-Pass through Benzol Still
Poor Coke Oven Gas
Producer Gas
Blue or Carburetted Water Gas
Tar Oil for Benzol Extraction

FIG. 6.—ARRANGEMENT OF GAS PLANT FOR COKE-OVENS (UNITED COKE AND GAS COMPANY).

for illuminating gas, from which it goes into the city. The poor gas, after being treated in the same manner as the rich gas, leaves the ammonia washers 6 and passes through two benzol scrubbers 13 and 14. After having been freed of its benzol, it flows through pipe 15 into the oven gasholder 16. Here it is mixed with producer gas, when necessary (which will be discussed later), and carried to the ovens for heating by the pipe 17. The benzol extracted from the poor gas is then transferred to the rich gas, so as to increase its candle power.

The tar oil by which the gas is washed, runs first from tank 18, through the second benzol scrubber 14, into tank 19. From here it is supplied by pump 19-A into the first benzol scrubber 13. The tar oil enters from tank 18 with about 5 per cent. of benzol, and finally leaves washer 13 with about 15 per cent. of benzol. It is collected in tank 20. From here it is fed by pump 20-A into still 21, in which the benzol is reduced again to about 5 per cent. The exhausted oil collects in tank 22. From here it is taken by pump 22-A through the oil-cooler 23, in order to be again supplied to tank 18 for a new absorption.

A small additional plant is needed (which, however, has been omitted in this sketch), by which a small percentage of the oil is revivified, in order to keep it active for benzol absorption. This consists of a simple tar-still and condenser, in which the tar oil is freed from most of the naphthalene and other hydrocarbons incidentally absorbed.

The presence of an excessive percentage of them in the tar oil would interfere with a complete benzol absorption. The benzol vapours which are driven off in still 21 are carried into the rich gas system by means of a gas current coming from the pressure side of the rich gas condensing plant. This greatly facilitates the distillation of the tar oil passing through the still. The mixture of the gas and benzol vapours then passes through pipe 24, preferably to the inlet of the exhausters 10 of the rich gas condensing plant. In this manner, the vapours do not come in contact with a large body of tar, which would be liable to absorb a part of the benzol.

[It is unnecessary to describe here the details of the benzol distilling plant. A great number of these are in operation in connection with German bye-product coke plants.]

AUXILIARY GAS PLANT.

When operating the plant continuously, practically the same amount of surplus gas is obtained every day, and the plant would not be adapted to follow the fluctuations in the gas consumption. The plant is consequently so designed that its surplus gas will meet the minimum requirements in summer time; and the increased requirements in winter are made up by an auxiliary gas plant.

Two ways suggest themselves in connection with the bye-product coke-ovens—

(1) *An Auxiliary Producer Plant.*—Producers are operated preferably on coke screenings and refuse coke, which finds a sale only at a reduced price. The producer gas thus obtained is mixed with the poor coke-oven gas and burnt under the ovens. In this manner, more rich gas becomes available. Such a plant is now in operation at the New England Gas and Coke Company's works, with exceedingly good results in regard to heat efficiency—*i.e.*, 90 per cent. of the fuel value of the coke charged into producers is accounted for in the increased volume of rich gas. (This plan has not been shown in the accompanying sketches.)

(2) *Auxiliary Water-Gas Plant.*—Instead of a producer plant, a water-gas plant may be added to the coke-ovens, as is indicated in fig. 6. This plant may be operated in three ways:

(*a*) As a producer plant. By shutting valve 27 permanently and opening valve 25, the generator 26 is permanently used as a producer. A mixture of air and steam is blown through the incandescent fuel bed; and the gas, after being scrubbed in 40, passes through pipe 41 into the oven gasholder, where it mixes with the poor coke-oven gas and is sent to the coke-ovens for heating.

(*b*) As a carburetted water gas plant. By shutting valve 25 and opening valve 27, the plant becomes an ordinary carburetted water-gas plant with generator 26, carburettor 28, superheater 29, washer 30, condensers 31 and 32, and relief holder 34. The carburetted water gas is sent through the exhauster 35, and through the purifying plant 37, into the large storage holder for illuminating gas. It is evident that such an equipment affords a most valuable reserve in case of coal shortage, strikes, &c.

(*c*) Combined producer and water-gas plant. When blowing air through the generator, valve 25 is opened and the producer gas passes through scrubber 40 into the oven-fuel gasholder 16. When the fuel bed thus becomes hot, valve 25 is closed and valve 27 is opened; while steam is blown through the generators. The resulting blue water gas passes through the entire set of water-gas apparatus 28 to 32, while, however, no oil is fed into the carburettor. The blue water gas is finally taken from the storage holder 34, by means of exhauster 35, and mixed with the rich gas coming through pipe 42 at the entrance of the purifying house 37. The mixture of the gas then passes into the storage holder and thence into the city. The candle power in the rich gas would, of course, be reduced by the admixture of blue water gas; but this is made up by the benzol which is transferred from the poor gas to the rich gas, as described above. The admixture of water gas, with its high percentage of hydrogen and carbon monoxide, to the rich coal gas, has advantages which will be discussed later on.

Discovery of Tar and Ammonia.—The tar and gas liquor which are collected in the condensing plant are treated in the same manner as is generally practised in gas and bye-product coke-works; and the description of the detailed arrangement of the ammonia house and tar separators may be omitted here. Whether concentrated ammoniacal liquor or sulphate of ammonia is to be produced depends on local conditions.

THE PRINCIPLES OF THE DRY DISTILLATION OF COAL IN COKE-OVENS.

Bituminous coal, when it is exposed in closed retorts to a high temperature, gives the following products: (1) Coke,

remaining as a residue in the retort; (2) tar; (3) gas-liquor, from which subsequently by distillation ammonia products are obtained; and (4) coal gas, which contains benzol and its homologues in vapour form. From the gas, there are at times additional products extracted—viz., cyanogen and sulphur; but this will not be discussed here.

In order to show the variations in the yields of different coals, I will give the results obtained on some coals in Otto-Hoffmann coke-ovens (Table V.).

TABLE V.—*Yields of Various American Coals used in Otto-Hoffmann Ovens.*

Plant Used.	Coke. Per Cent.	Tar. Per Cent.	Sulphate. Per Cent.	Total Gas per 2000 Pounds, Cubic Feet.
Average Operating Results—				
Dominion, Cape Breton Coal, Everett, Mass.	72·83	4·99	1·010	About 9,000
Youghiogheny, Penn., Coal, Glassport, Pa.	75·60	5 07	1·100	,, 9,000
Westphalian Coal (Germany).	74·50	3·70	1·280	,, 9,600
Distillation Test—				
Connellsville, Penn., Coal.	76·34	6 14	1·223	,, 8,924
Pittsburgh, Penn., Coal.	68·25	4·38	0·908	,, 8,884
Coal from Eastern Part of Penn	85·00	2 00	0·800	,, 8,400
Virginia Coal	66·01	4·70	1·070	,, 10,090
Kanawha, W. Va., Coal.	73·60	6 40	1·000	,, 10,289

All these coals are true bituminous coals, geologically belonging to the carboniferous system. We have also investigated several lignites of the cretaceous period, which give very different results.

The above-mentioned carboniferous coals show a very great variation. It is seen that the gas yields do not change in the inverse proportion of the coke yields. Thus, coals which yield about 72 to 76 per cent. of coke, render a surplus of between 3000 and 4000 cubic feet of gas per net ton, from a total of 9000 to 9500 cubic feet. In the case of a higher coke yield (Eastern Pennsylvania coal renders 85 per cent. of coke), we obtain about the same amount of gas—*i.e.*, 8000 to 9000 cubic feet. But this is of such a low heat value, that all the gas is needed for heating the coke-oven; thus there is no surplus. Hence the limit for operating coke-ovens appears to be with coals yielding from 85 to 87 per cent. of coke.

Very good results are obtained with Virginia and West Virginia coals. Two thousand pounds of these coals yield 66 per cent. of coke and 10,090 cubic feet of gas of very satisfactory value. By separating the quantity of gas recovered into two fractions—viz., rich and poor gas—and using the former for illumination, while the latter is employed as fuel gas under the retorts, we are enabled to use other than gas coals. Connellsville, Youghiogheny, or any other kind of ordinary coking coal, furnishes a gas of 18 to 20 candle power. Even slack coal gives a very high-grade illuminating gas; but in this case, the coke obtained has to be used for domestic purposes.

Results of Dry Distillation of Dominion (Nova Scotia) Coal.

The coal from the International Seam of the Dominion Coal Company at Cape Breton, Nova Scotia, which is now being used by the New England Gas and Coke Company, in their 400 Otto-Hoffmann coke-ovens at Everett, near Boston (Mass.), has been investigated in detail. The 400 Otto-Hoffmann coke-ovens of the Dominion Iron and Steel Company at Sydney (Cape Breton) run on coals from the same field. We give the more important results in detail—

TABLE VI.—*Summary of Results of Dominion Coal Test at Glassport, Pa.*

Product of 1 Long Ton of Coal.	Pounds.	Per Cent.
Coke	1593·4	71·13
Tar	75·7	3·38
Ammonia (= 1·373 per cent. sulphate)	7·6	0·34
Gas, total 10,390 cub. ft., of ·466 sp. gr.	368·0	16·43
Sulphur compounds of gas—		
Hydrogen sulphide (H_2S) 0·98 lb. per 1000 cub. ft.	10·8	0·48
Carbon disulphide (CS_2) 0·13 lb. per 1000 cub. ft.	1·6	0·07
Gas liquor and loss, by difference	182·9	8·17
Total	2240·0	100·00

These and the following results were obtained by averaging the determinations of four consecutive oven charges at the plant of the Pittsburg Gas and Coke Company at Glassport, Pa., whither the Dominion coal had been shipped in September, 1897. The test plant was not completed before February, 1898. In the meantime, the coal had been exposed to the weather.

Test-Ovens.—The test-oven was of the Otto-Hoffmann regenerative type, 33½ feet long, 5 ft. 10 in. high, and on an average 20¾ inches wide (19½ and 22 inches). The coking time was on an average nearly 34 hours.

Coal and Coke.—The slack coal, when charged, contained 9·9 per cent. of moisture. The crucible tests showed the following results:—

TABLE VII.—*Crucible Tests of the Dominion Coal and Coke.*

	Dry Coal.		Dry Coke.
Volatile matter	34·60 per cent.	..	1·27 per cent.
Fixed carbon	59·56 ,,	..	89·82 ,,
Ash	5·84 ,,	..	8·91 ,,
Total	100·00 per cent.	..	100·00 per cent.
Sulphur, fixed	1·696	..	2·406
,, volatile	1·058	..	0·020
Total	2·754	..	2·426
Phosphorus	0·0026	..	0·0041

The sulphur in the coal is considerably reduced in the coal used at Everett and Sydney by washing. Eliminating the ash from both coke and coal, it is found that of the coal substance enters into the coke: In the crucible test, 63·25 per cent.; in the large oven test, 68·81 per cent. This shows that the results of the ordinary crucible tests offer no reliable indication of the actual yield in the coke-oven, which is easily understood, when comparing the great difference between the coking in the crucible and coke-oven.

TABLE VIII.—*Ultimate Analyses of Dominion Coal and Coke.*

	Coal. Per Cent.		Coke. Per Cent.
Carbon	75·10	..	86·42
Hydrogen	3·75	..	1·06
Nitrogen	1·51	..	0·73
Oxygen	11·05	..	0·46
Ash	5·84	..	8·91
Sulphur	2·75	..	2·42
Total	100·00	..	100·00

Calorific value (Dulong-Mahler formula): Coal, 12,437; coke, 13,305.

The coal substance (free of ash) contains 2·52 per cent. of disposable hydrogen. The specific gravity of the dry coal was 1·28. When dried at 110° C., cooled, weighed, and afterwards put under a glass bell, the coal absorbed from the moist atmosphere 4·01 per cent. of water at 16° C.

The following table gives a comparison of the analysis of the Dominion coke ash with the ash from Connellsville (Penn.) beehive coke, Phelan coke (from another Cape Breton coal) and Pennsylvania anthracite.

TABLE IX.—*Analyses of Ash.*

—	—	Connellsville Coke by E. Pechin.	International Coke.	Phelan Coke.	Anthracite from Lehigh Coal and Navigation Co.'s Panther Creek Mine.	
					Red Ash.	White Ash.
Silica	SiO_2	57·48	27·71	26·65	47·19	48·25
Alumina	Al_2O_3	34·64	13·04	12·50	32·52	36·18
Oxide of iron	Fe_2O_3	5·09	50·60	46·45	4·71	3·29
Oxide of manganese	Mn_3O_4	—	0·25	0·70	trace	trace
Lime	CaO	2·58	4·61	6·15	3·64	1·95
Magnesia	MgO	0·08	0·77	1·43	0·97	0·92
Potassium oxide	K_2O	trace	0·85	0·64	7·31	7·25
Sodium oxide	Na_2O		0·18	0·41		
Sulphuric acid	SO_3	—	2·62	5·01	0·71	0·49
Phosphoric acid	P_2O_5	0·13	0·10	0·25	1·96	0·92
Titanic acid	—	—	—	—	0·99	0·75
Total		100·00	100·00	100·00	100·00	100·00

The washing of the coal will reduce the percentage of oxide of iron in the Dominion coal ash. The composition of the coke ash is of great importance, especially when the coke is to be used for domestic purposes. The more fluxible ash is liable to form undesirable clinkers. The annual coke yield at Everett is, on an average, 72·8 per cent., as against 71·13 per cent. in the test.

Tar.—The yield of tar in the test was 3·38 per cent.; while the actual results got at Everett are on an average

4·99 per cent. The difference is possibly due to exposure of the test coal, as stated above.

Table X. shows the result of the fractional distillation of the Dominion test, as compared with the other tars.

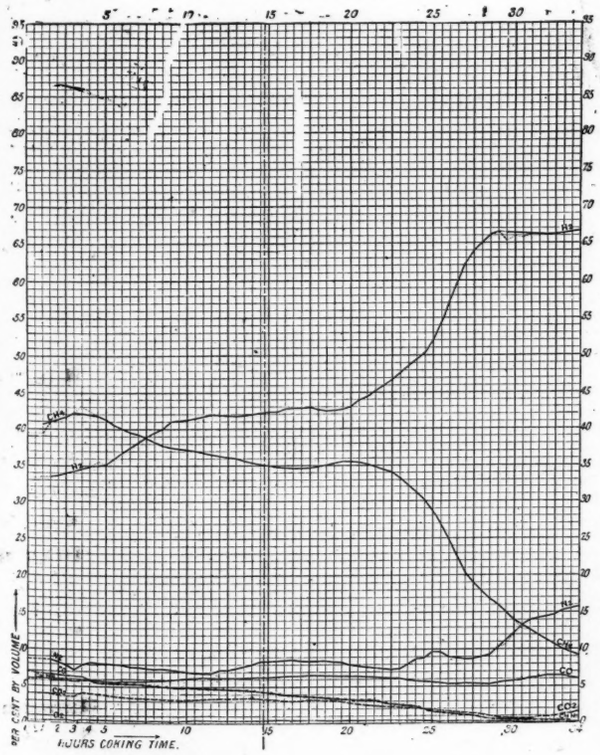
TABLE X.

Fractions.	Temperature Deg. C.	Otto-Hoffmann Coke-Oven Tar.				Gas-Works Tar.		
		Dominion Coal-Test.	Dominion Coal Everett.	Dominion Coal Sydney.	Germania Plant (Westphalia).	German.	German.	American.
Light oil . . .	80-170	3·7	1·26	1·38	6·55	3·0	2·5	1·65
Middle oil . .	170-230	9·8	14·73	11·46	10·54	7·5	2·5	10·66
Heavy oil. . .	230-270	12·0	7·07	8·56	7·62	33·5	25·0	8·18
Anthracene oil .	over 270	43·0	21·38	20·63	44·35	10·5	10·0	14·05
Pitch	—	67·0	53·03	53·68	30·55	45·5	60·0	61·16
Water. . . .	—	2·3	1·52	1·93	trace	—	—	1·81
Loss	—	0·9	1·01	1·38	0·39	—	—	2·48
Total	—	100·0	100·00	100·00	100·00	100·0	100·0	—
Fixed carbon p.c.	—	8 p.c.	8-10 p.c.	5·35	—	15 p.c.	25 p.c.	—
Spec. gravity .	—	1·170	1·188	1·14	1·1198	1·155	1·155	—

The low percentage of free carbon in coke-oven tar, as compared with gas-works tar, is a great advantage. Pitch also is of very much higher quality when produced from coke-oven tars. The softening point of the Everett test pitch is 87° C.

Ammonia.—The total gas liquor produced was found, by difference, to be about 8·17 per cent. of the dry coal. The ammonia yield, calculated as sulphate, was found in the test as 1·373 per cent. As nitrogen in the coal is 1·51 per cent., it is found that 18·5 per cent. of the total nitrogen in the coal has been converted into ammonia, which is a very high figure. The actual yield of the operations at Everett has not produced such a high percentage of sulphate of ammonia. The yield is, on an average, only slightly above 1 per cent.

Gas from Dominion Coal.—The gas was analyzed frequently, and the results are shown in Table XII.



Surplus gas produced during the first 14 h. 46 m.
Volume per long ton, 5143 cu. ft. = 49·5 per cent.

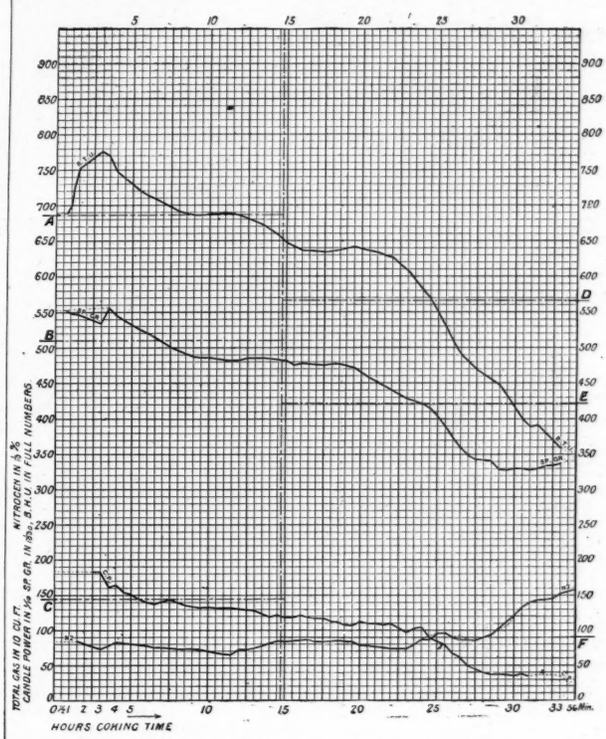
	$C_m H_n$	CH_4	H_2	CO	CO_2	O_2	N_2	Total.
Average analysis:	5·2	38·7	38·4	6·1	3·6	0·3	7·7	100

Oven-heating gas produced during the remaining 19 h. 10 m.
Volume per long ton, 5247 cu. ft. = 50·5 per cent.

	$C_m H_n$	CH_4	H_2	CO	CO_2	O_2	N_2	Total.
Average analysis:	2·4	29·2	50·5	6·3	2·2	0·3	9·1	100

FIG. 7.—ANALYSES OF DOMINION COAL GAS PRODUCED IN COKE-OVEN TEST.

On the basis of these determinations, Table XIII. has been computed, which shows the cumulative results for the average of the gas up to and including each hour. In order to more easily observe the changes in the quality of the gas analyzed, the results, as contained in this table, have been illustrated in a set of graphical charts—figs. 7, 8, and 9. From these, it will be seen that the coking process may be divided into three distinct periods. During the first period, the coal is heated up, and a gas very rich indeed in



A. Average Calorific Value of Surplus Gas, 685·8 B.T.U.
B. Average Specific Gravity of Surplus Gas = ·512.
C. Average Illuminating Value of Surplus Gas = 14·7-candle power.
D. Average Calorific Value of Oven-Heating Gas, 566·7 B.T.U.
E. Average Specific Gravity of Oven-Heating Gas ·421.
F. Average Illuminating Value of Oven-Heating Gas, 9-candle power.

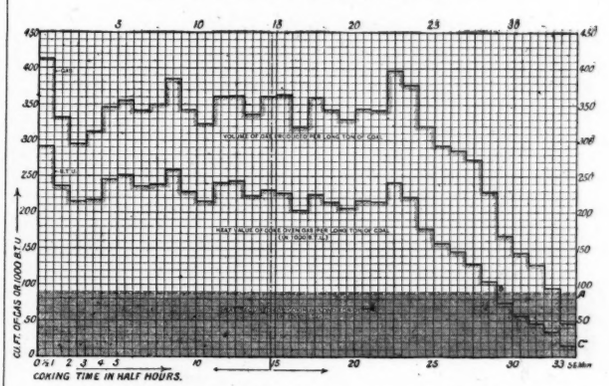
Surplus gas produced during first 14 h. 46 m.:

Average calorific value	685·8 B.T.U.
Average illuminating value (gas not purified of CO_2)	14·7 C.P.
Average specific gravity value	·512
Volume per long ton, 5143 cubic feet =	49·5 per cent.

Oven-heating gas produced during remaining 19 h. 10 m.

Average calorific value	566·7 B.T.U.
Average illuminating value (gas not purified of CO_2)	9·0 C.P.
Average specific gravity value	·421
Volume per long ton, 5247 cubic feet =	50·5 per cent.

FIG. 8.—THE CALORIFIC VALUE, SPECIFIC GRAVITY, AND CANDLE POWER OF DOMINION COAL GAS PRODUCED IN COKE-OVEN TEST.



A.—Line representing calorific value of gas used for heating the ovens 87,633 B.T.U. per long ton per hour (532,090 B.T.U. per long ton for entire coking time).

	Volume. Cub. Ft. Per Cent.	Calorific Value. B.T.U. Per Cent.
Surplus gas produced during first 14 h. 46 m.	5143 = 49·5	3,527,320 = 54·2
Surplus gas produced during remaining 19 h. 10 m.	5247 = 50·4	2,973,680 = 45·8

FIG. 9.—VOLUME AND TOTAL CALORIFIC VALUE OF DOMINION COAL GAS PRODUCED IN COKE-OVEN TEST.

TABLE XII.—*Hourly Analyses of Dominion Coal Gas Produced in Coke-Oven Test.*

	Hours after Charging.	Analyses of Gas Produced.							Analyses of Gas Free of N_2 and O_2.					Specific Gravity of Gas from Sheet 18.	Calorific Value of Gas Produced.	Candle Power of Gas Not Freed of CO_2.	Gas Produced During Each Hour—per Long Ton of Dry Coal. Cubic Feet.	Heat Value of Gas Produced During Each Hour—per Long Ton of Dry Coal. B.H.U.	Illuminating Value of Gas Not Freed of CO_2 Produced During Each Hour—per Long Ton of Dry Coal. Candle Feet.
		$C_m H_n$.	CH_4.	H_2.	CO.	CO_2.	O_2.	N_2.	$C_m H_n$.	CH_4.	H_2.	CO.	CO_2.						
Surplus gas first 14 hrs. 46 min.	1	5·8	40·3	34·3	6·8	3·9	0·2	8·7	6·8	44·0	37·6	7·7	3·9	·552	707	18·4	413	292,000	7,599
	2	5·8	41·2	33·6	6·7	3·8	0·3	8·6	6·7	44·6	37·2	7·5	4·0	·547	707	18·4	333	236,000	6,127
	3	5·8	41·8	34·0	6·5	3·7	0·3	7·9	6·5	44·9	37·3	7·3	4·0	·539	736	18·4	295	217,000	5,428
	4	5·7	41·5	34·1	6·3	4·2	0·4	7·8	6·5	45·4	37·1	6·7	4·3	·555	699	16·2	312	218,000	5,054
	5	5·7	41·5	34·8	5·8	3·9	0·3	8·0	6·4	45·3	37·7	6·4	4·2	·539	709	15·4	347	246,000	5,344
	6	5·4	40·7	36·1	5·7	3·7	0·4	8·0	6·2	44·4	39·2	6·3	3·9	·527	703	14·4	357	251,000	5,141
	7	5·4	39·6	37·6	5·8	3·5	0·4	7·7	5·9	43·4	40·8	6·2	3·7	·515	693	13·8	342	237,000	4,720
	8	5·2	38·8	39·0	5·7	3·4	0·3	7·6	5·7	42·4	42·2	6·1	3·6	·502	683	14·5	350	239,000	5,075
	9	5·0	37·8	40·2	5·9	3·3	0·3	7·5	5·4	41·5	43·5	6·3	3·4	·492	671	13·7	386	259,000	5,288
	10	4·9	37·4	41·2	5·9	3·2	0·3	7·1	5·3	40·6	44·3	6·4	3·4	·486	666	13·3	344	229,000	4,575
	11	4·9	37·0	41·5	6·2	3·2	0·3	6·9	5·3	40·1	44·7	6·5	3·4	·484	667	13·2	324	216,000	4,277
	12	4·8	36·5	42·0	6·3	3·3	0·3	6·8	5·2	39·4	45·3	6·6	3·5	·482	666	13·2	362	241,000	4,778
	13	4·7	36·2	41·9	6·1	3·4	0·4	7·3	5·0	39·3	45·4	6·7	3·6	·485	672	13·0	363	244,000	4,719
	14	4·5	35·7	41·9	6·2	3·5	0·3	7·9	4·7	39·2	45·7	6·7	3·7	·485	665	12·3	337	224,000	4,145
Oven fuel gas last 19 hrs. 10 min.	15	4·4	35·3	42·1	6·2	3·3	0·4	8·3	4·5	38·8	46·2	6·8	3·7	·483	638	12·1	362	231,000	4,380
	16	4·1	34·9	42·4	6·3	3·3	0·4	8·6	4·3	38·6	46·6	7·0	3·5	·478	624	11·9	364	227,000	4,331
	17	3·8	34·7	42·9	6·5	3·0	0·4	8·7	4·2	38·3	46·9	7·2	3·4	·478	642	11·9	318	204,000	3,784
	18	3·7	34·7	42·9	6·6	3·2	0·4	8·5	3·9	38·3	47·0	7·3	3·5	·477	628	11·8	360	226,000	4,248
	19	3·5	35·2	42·6	6·5	3·2	0·4	8·6	3·8	38·8	46·7	7·3	3·4	·478	623	11·1	345	215,000	3,829
	20	3·4	35·1	42·7	6·5	3·0	0·4	8·4	3·6	39·3	46·6	7·3	3·2	·473	624	10·6	330	206,000	3,498
	21	3·2	35·4	44·0	6·5	2·7	0·4	7·8	3·5	38·6	47·7	7·2	3·0	·458	624	11·0	346	216,000	3,806
	22	3·1	34·8	45·4	6·3	2·5	0·4	7·5	3·2	37·9	49·2	6·9	2·8	·447	625	10·8	344	215,000	3,715
	23	2·8	34·1	46·8	6·1	2·4	0·4	7·4	2·9	36·9	50·6	6·8	2·6	·434	608	10·3	396	241,000	4,079
	24	2·5	32·3	48·7	5·9	2·2	0·4	8·0	2·6	35·2	53·1	6·6	2·5	·425	583	10·3	378	221,000	3,893
	25	2·0	30·3	50·5	5·7	2·0	0·3	9·2	2·1	33·4	55·5	6·3	2·3	·415	556	9·0	320	178,000	2,880
	26	1·5	26·8	54·5	5·5	1·8	0·3	9·6	1·8	29·6	60·3	6·2	2·1	·390	534	7·8	294	157,000	2,293
	27	1·3	22·7	59·9	5·4	1·5	0·3	8·9	1·4	25·3	65·6	6·0	1·7	·361	510	6·3	286	146,000	1,802
	28	1·0	19·2	64·0	5·4	1·3	0·3	8·8	1·2	20·8	70·4	5·9	1·6	·343	469	4·5	275	129,000	1,237
	29	0·7	16·9	66·2	5·4	1·1	0·3	9·3	0·7	18·5	73·6	5·9	1·3	·341	456	3·8	228	104,000	866
	30	0·6	15·2	66·4	5·6	0·8	0·2	11·2	0·6	17·0	75·0	6·2	1·2	·328	440	3·7	168	74,000	622
	31	0·5	13·3	66·3	5·8	0·7	0·1	13·3	0·6	15·0	76·8	6·6	1·0	·330	389	3·8	144	56,000	547
	32	0·4	12·0	66·2	6·3	0·8	0·1	14·2	0·6	14·0	78·1	6·5	0·8	·330	362	3·6	127	46,000	457
	33	0·4	10·8	66·2	6·6	1·0	0·2	14·8	0·5	12·9	79·5	6·5	0·6	·335	362	3·5	94	34,000	329
	34	0·2	9·6	66·7	6·4	1·3	0·2	15·6	0·4	11·9	80·7	6·5	0·5	·338	565(?)	2·5	46	26,000	115
															Total.	. .	10,390	6,501,000	122,981

marsh gas and hydrocarbons is obtained. During the second period, the coking gradually progresses to the centre of the charge, and a coal gas of almost constant quality is produced. At the beginning of the third period, the heat has penetrated both side walls of the retort to the centre of the charge, and then the heat increases rapidly. This results in the production of a gas very much richer in hydrogen. The coking time was 34 hours in the 20¾-inch oven.

If the process had been carried on in a narrower oven, the same results would have been obtained in a shorter time. The sudden change which takes place in the character of the gas after the twenty-second hour is explained by the fact that the heat has at that time penetrated to the centre of the coal charge. The amount of gas produced at that time decreases considerably. Unless proper provision is made, the pressure in the retort decreases, in consequence of which

TABLE XIII.—*Analyses of Dominion Coal Gas Produced in Coke-Oven Test, Showing Results up to and including Each Hour.*

	Number of Hours.	Analyses of Gas Produced.							Analyses of Gas Free of N_2 & O_2.					Specific Gravity of Gas		Calorific Value of Gas.		Candle Power of Gas not Freed of CO_2.	Total Quantities Produced for Long Ton Dry Coal.		
		$C_m H_n$.	CH_4.	H_2.	CO.	CO_2.	O_2.	N_2.	$C_m H_n$.	CH_4.	H_2	CO.	CO_2.	With.	Without.	With.	Without.		Gas Cubic Feet.	Calorific Vaule B. H. U.	Illuminating Value Candle-Feet Gas not freed of CO_2.
														N_2 & O_2.		N_2 & O_2.					
Surplus gas first 14 hrs. 46 mins.	1	5·8	40·3	34·3	6·8	3·9	0·2	8·7	6·4	44·2	37·6	7·5	4·3	·552	·510	707	776	18·4	413	292,000	7,599
	2	5·8	40·7	34·0	6·8	3·8	0·2	8·7	6·4	44·6	37·3	7·5	4·2	·550	·508	709	778	18·4	746	528,000	13,726
	3	5·8	41·0	34·0	6·7	3·8	0·2	8·5	6·4	44·9	37·2	7·3	4·2	·547	·505	716	773	18·4	1,041	745,000	19,154
	4	5·8	41·1	34·1	6·6	3·9	0·3	8·2	6·3	44·9	37·3	7·2	4·3	·549	·509	712	778	17·9	1,353	963,000	24,203
	5	5·8	41·2	34·2	6·4	3·9	0·3	8·2	6·3	45·0	37·4	7·0	4·3	·547	·507	705	770	17·4	1,700	1,209,000	29,552
	6	5·7	41·1	34·5	6·3	3·9	0·3	8·2	6·2	44·9	37·7	6·9	4·3	·543	·503	709	775	16·8	2,057	1,460,000	34,693
	7	5·6	40·9	35·0	6·2	3·9	0·3	8·1	6·1	44·7	38·2	6·8	4·2	·540	·500	707	772	16·4	2,399	1,697,000	39,413
	8	5·6	40·6	35·4	6·2	3·8	0·3	8·1	6·1	44·3	38·6	6·8	4·2	·535	·495	704	769	16·2	2,749	1,936,000	44,488
	9	5·5	40·2	36·1	6·2	3·7	0·3	8·0	6·0	43·8	39·4	6·8	4·0	·529	·489	701	764	15·8	3,135	2,195,000	49,776
	10	5·5	39·8	36·6	6·1	3·7	0·3	8·0	6·0	43·4	39·9	6·7	4·0	·525	·483	697	760	15·6	3,479	2,424,000	54,351
	11	5·4	39·4	37·2	6·1	3·7	0·3	7·9	5·9	42·9	40·6	6·6	4·0	·521	·480	690	752	15·4	3,803	2,640,000	58,628
	12	5·4	39·3	37·5	6·1	3·7	0·3	7·7	5·9	42·7	40·8	6·6	4·0	·518	·478	692	752	15·2	4,165	2,881,000	63,406
	13	5·3	39·1	37·9	6·1	3·6	0·3	7·7	5·8	42·5	41·2	6·6	3·9	·516	·476	690	750	15·0	4,528	3,125,000	68,125
	14	5·3	38·8	38·2	6·1	3·6	0·3	7·7	5·8	42·2	41·5	6·6	3·9	·513	·473	688	748	14·8	4,865	3,349,000	72,270
		5·2	*38·7*	*38·4*	*6·1*	*3·6*	*0·3*	*7·7*	*5·7*	*42·0*	*41·8*	*6·6*	*3·9*	*·512*	*·472*	*685·8*	*744*	*14·7*	*5,143*	*3,527,320*	*75,628*
Oven fuel gas last 19 hrs. 10 mins.	15	5·2	38·6	38·5	6·1	3·6	0·3	7·7	5·7	41·8	42·0	6·6	3·9	·511	·472	685	743	14·6	5,227	3,580,000	76,650
	16	5·1	38·4	38·7	6·2	3·5	0·3	7·8	5·6	41·8	42·1	6·7	3·8	·509	·468	680	740	14·4	5,591	3,807,000	80,981
	17	5·1	38·1	39·0	6·2	3·5	0·3	7·8	5·6	41·5	42·4	6·7	3·8	·507	·465	679	739	14·3	5,909	4,011,000	84,765
	18	4·8	37·9	39·4	6·2	3·5	0·3	7·9	5·2	41·3	43·0	6·7	3·8	·505	·464	676	736	14·2	6,269	4,237,000	89,013
	19	4·9	37·8	39·3	6·3	3·5	0·3	7·9	5·3	41·2	42·9	6·8	3·8	·504	·462	673	733	14·0	6,614	4,452,000	92,842
	20	4·8	37·7	39·6	6·2	3·5	0·3	7·9	5·2	41·1	43·1	6·8	3·8	·503	·461	671	731	13·9	6,944	4,658,000	96,340
	21	4·7	37·6	39·9	6·2	3·4	0·3	7·9	5·1	41·0	43·4	6·8	3·7	·501	·459	669	730	13·7	7,290	4,874,000	100,146
	22	4·7	37·4	40·1	6·2	3·4	0·3	7·9	5·1	40·8	43·6	6·8	3·7	·498	·456	667	727	13·6	7,634	5,083,000	103,861
	23	4·6	37·2	40·4	6·2	3·3	0·4	7·9	5·0	40·6	44·0	6·8	3·6	·495	·452	664	724	13·4	8,030	5,330,000	107,940
	24	4·5	37·0	40·7	6·2	3·3	0·4	7·9	4·9	40·4	44·3	6·8	3·6	·492	·449	660	720	13·3	8,408	5,551,000	111,833
	25	4·4	36·8	41·2	6·2	3·2	0·3	7·9	4·8	40·4	44·8	6·8	3·5	·490	·448	656	715	13·1	8,728	5,729,000	114,713
	26	4·3	36·5	41·5	6·2	3·2	0·3	8·0	4·7	39·8	45·2	6·8	3·5	·485	·442	652	711	12·9	9,022	5,886,000	117,026
	27	4·2	36·0	42·0	6·2	3·1	0·3	8·2	4·6	39·3	45·9	6·8	3·4	·482	·435	648	708	12·8	9,308	6,032,000	118,808
	28	4·1	35·6	42·7	6·1	3·1	0·3	8·1	4·5	38·8	46·6	6·7	3·4	·478	·433	643	702	12·5	9,583	6,161,000	120,045
	29	4·0	35·1	43·2	6·2	3·0	0·4	8·1	4·4	38·3	47·2	6·8	3·3	·475	·429	639	698	12·3	9,811	6,265,000	120,911
	30	4·0	34·8	43·6	6·2	3·0	0·3	8·1	4·4	38·0	47·6	6·8	3·3	·472	·427	635	693	12·2	9,979	6,339,000	121,533
	31	3·9	34·5	43·9	6·2	3·0	0·3	8·2	4·3	37·7	47·9	6·8	3·3	·470	·423	632	691	11·9	10,123	6,395,000	122,080
	32	3·9	34·2	44·2	6·2	2·9	0·3	8·3	4·3	37·4	48·3	6·8	3·2	·468	·420	628	687	11·9	10,250	6,441,000	122,537
	33	3·9	33·9	44·4	6·2	2·9	0·3	8·4	4·3	37·1	48·6	6·8	3·2	·467	·418	625	685	11·8	10,344	6,475,000	122,866
	34	3·8	33·9	44·5	6·2	2·9	0·3	8·4	4·2	37·1	48·7	6·8	3·2	·465	·417	625	683	11·8	10,390	6,501,000	122,981
		2·4	*29·2*	*50·5*	*6·3*	*2·2*	*0·3*	*9·1*	*2·7*	*32·2*	*55·7*	*7·0*	*2·4*	*·421*	*·363*	*567*	*665*	*9·0*	*5,247*	*2,973,680*	*47,353*

more air is liable to enter into the retort through cracks in the door luting. This is clearly shown in the graphical chart (fig. 7), where the nitrogen gradually increases after the twenty-second hour. If this nitrogen be eliminated from the analysis as an incidental impurity (see Table XII., second column), it would be found that the gas substance in the first hour shows 44 per cent. of marsh gas and 37·6 per cent. of hydrogen; while at the end it shows 11·9 per cent. of marsh gas and 80·7 per cent. of hydrogen.

As it will be possible to separate any fraction of the gas, and concentrate the vaporous illuminants in the same, it is understood that a wide variation in the character of the coal-gas flame can be produced at will. But this will be discussed more fully later on.

In these tables the candle power had been given, as observed in the gas freed of carbonic acid—only the sulphuretted hydrogen having been removed. The improvement in the candle power by the removal of the carbonic acid, will be discussed later on (see Table XXI).

The graphical chart (fig. 9) shows the quantity of the gas produced during each hour, and also the total heat value of this gas. The quantity of gas burned under the retort was carefully measured, and its calorific value determined; so that we were able to ascertain the total heat value of the gas consumed. This is, of course, an almost constant amount for the entire coking test. It will be seen that at the twenty-ninth hour the amount of heat obtained in the coal gas becomes less than the amount of heat consumed by the oven. In other words, it takes more heat to drive out the last traces of volatile constituents from the coke than is produced in the gas. If metallurgical coke is required, it is necessary to carry on the coking operation to the almost complete expulsion of volatile matter. If domestic coke is required, this is not necessary; and the coking operation can be conveniently interrupted at the twenty-ninth hour—provided the block of coke is sufficiently solid to allow of its being pushed from the oven. In that way, an additional amount of heat, represented by the spaces A, B, C, on the graphical chart (fig. 9), is saved. Furthermore, the coking period is shortened from 34 to 29 hours—a considerable increase in the capacity of the plant.

Having ascertained the total amount of heat required by the oven, we deducted this amount from the total heat produced in the gas, and were able to indicate the division line in the surplus and the coke-oven heating gas, as shown in Table XIII. The coke-oven is then operated, so as to collect in one main the entire gas produced during the first fourteen hours, and treat this in the rich-gas side of the condensing house. After purification, this gas would be sent to the city. The second half, from the fifteenth to the thirty-fourth hours inclusive, is freed from tar and ammonia, and returned to the coke-ovens for heating. The heat-balance for the coke-oven gas, according to the results obtained in the Glassport test, as contrasted with the present actual results, is very clearly shown in Tables XIV. and XV.

TABLE XIV.—*Heat-Balance for Dominion Coal Gas from Coke-Oven Test at Glassport, Pa.*

Per Long Ton, Dry Coal.	Volume.		Calorific Power.	
	Cu. Ft.	Per Cent.	B. H. U.	Per Cent.
Surplus gas	5,143	49·5	3,527,320	54·2
Gas used for heating oven .	5,247	50·5	2,973,680	45·8
Total gas consumed. .	10,390	100·0	6,501,000	100·0

TABLE XV.—*Present Actual Operating Results at Everett.*

Per Long Ton, Dry Coal.	Volume.		Calorific Power.	
	Cub. Ft.	Per Cent.	B. H. U.	Per Cent.
Surplus gas.	4,448	44·5	3,170,940	54·3
Gas used for heating ovens .	5,560	55·5	2,884,000	47·7
Total gas consumed. .	10,080	100·0	6,054,940	100·0

The comparison of the results of the test with the present practical operation in regard to gas analysis, &c., are shown in Table XVI.

The slight variations between test results and the practical operating results may be explained by the exposure of the test coal to the weather, as mentioned above. On the whole, it can be seen that, in all important points, the operating results approximate very closely the test results, and in the more important instances, exceed them. In other words, the Everett plant is fulfilling in every respect the expectations.

TABLE XVI.—*Comparison of Rich and Poor Gas from Dominion Coal, obtained during Glassport Test and in Present Operations at Everett.*

—	Rich Gas (Surplus).		Poor Gas (Oven-Heating Gas).	
	Glassport Test.	Everett.	Glassport Test.	Everett.
Illuminants (C_nH_n)	5·2	5·0	2·4	2·5
Marsh gas (CH_4)	38·7	37·4	29·2	29·2
Hydrogen (H_2)	38·4	44·3	50·5	51·8
Carbon monoxide (CO) . . .	6·1	6·2	6·3	5·0
Carbon dioxide (CO_2) . . .	3·6	2·9	2·2	2·0
Oxygen (O_2)	0·3	0·1	0·3	0·4
Nitrogen (N_2)	7·7	4·1	9·1	9·1
	100·0	100·0	100·0	100·0
Calorific value B.H.U. . . .	685·8	707·8	366·7	515·0
Candle power not freed of CO_2.	14·7	16·3	9·0	6·5
Do. freed of CO_2. .	17·4	18·5	10·6	8·0

HEAT-BALANCE.

If we trace the heat value of the coal to the various products of the dry distillation, we obtain the following results:—

TABLE XVII.

100 lbs. of Dry Coal Yields.	B. H. U. per lb.	Total Calorific Power.	Per Cent. of Calorific Power of Dry Coal.
71·13 lbs. of coke	12,645	899,456	72 3
3·38 lbs. of tar	12,210	51,410	4·1
229 cub. ft. of surplus gas . .	686	157,504	12·7
234 cub. ft. of heating gas . .	567	132,835	10·7
Ammonia liquor, sulphur in purifier, and loss . . .	—	2,496	0·2
Total = 100 lbs. dry coal		1,243,700	100·0

From this table, it will be seen that the carbonization of the coal is performed with an expenditure of 10·7 + 0·2 = 10·9 per cent. of the heat-value of the coal. This is a very low heat consumption; but with the new oven, which has been described above, we shall be able to still further decrease this figure.

A comparison of the heat expenditure in this process, as compared with the dry distillation of the coal in gas-retorts, is of great interest. Table XVIII. gives this comparison.

TABLE XVIII.—*Comparison of Heat Distribution in Products of Distillation from Otto-Hoffman Ovens and Ordinary Gas-Retorts.*

Heat contained in 100 lbs. of dry coal is distributed as follows:—	German Coal in Gas-Retorts.				Dominion Coal in Otto-Hoffman Ovens
				Average 1, 2, & 3.	
	1	2	3	4	5
In coke, saleable . . .	46·1	51·0	46·0	47·8	72·3
In coke used for heating retorts	10·1	14·0	10·0	11·4	—
In tar	5·5	5·8	6·9	6·1	4·1
In gas, saleable	21·0	20·0	23·0	21·3	12·7
In gas for heating ovens .	—	—	—	—	10·7
In ammonia liquor, sulphur in purifiers, and loss .	17·0	9·2	14·1	13·4	0·2
Total	100·0	100·0	100·0	100·0	100·0
Heat used and lost in distillation process . .	27·1	23·2	24·1	24·8	10·9
Heat contained in products	72·9	76·8	75·9	75·2	89·1
Total	100·0	100·0	100·0	100·0	100·0

* The above data were taken from the following sources:—
Col. 1.—W. von Oechelhaeuser, "Die Steinkohlen-Gasanstalten als Licht-Wärme-und Kraft Centralen."
Col. 2.—Körting, "Journal für Gasbeleuchtung," 1898, p. 660.
Col. 3.—Dr. E. Schilling, "Steinkohlenleuchtgas," p. 159.

Comparing the heat-balance of the two coal distillation

processes with the carburetted water-gas process, we find the following (see "Progressive Age," Sept. 1, 1899, p. 399):—

TABLE XIX.—*Efficiency of Gas-Making Processes.*

	Energy Wasted. Per Cent.	Energy Utilized. Per Cent.
1. Carburetted water-gas process	30·0	70·0
2. Gas-benches, average results (see above)	24·8	75·2
3. Otto-Hoffmann ovens, on Dominion coal (Glassport tests)	10·9	89·1

It is of great interest to compare the quantity of residuals obtained in the various gas processes. We find such a table in "Progressive Age," Sept. 1, 1899 (p. 391):—

TABLE XX.—*Residuals per* 1000 *Cubic Feet of Gas Sold.*

—	Carburetted Water Gas.	Coal Gas Good Retort Practice.	Improved Otto-Hoffmann Practice.
Candle-power of gas.	24	14	18
Coal or coke consumed	40 lbs. coke	224 lbs. coal	448 lbs. coal
Oil consumed	30 lbs. oil	..	..
Coke	..	110 lbs. poor	315 lbs. good
Tar	0·5 gallon	1·12 gallons	2·25 gallons
Sulphate of ammonia	..	1·8 lbs.	5·5 lbs.

Coal-gas benches and coke-ovens are compared upon the same coal; and the question of enriching in connection with these two processes has been disregarded in this table. It is seen that the amount of residual products per 1000 cubic feet of gas sold is by far the greatest in the coke-oven process; but this, on account of the better quality of the residuals, is rather an advantage. The experience in the United States has shown that the disposal of these products at satisfactory prices offers no difficulty whatever.

THE ENRICHING OF COKE-OVEN GAS.

The illuminants in coke-oven gas are: Vapours of benzol (C_6H_6), with its homologues toluol (C_7H_8) and xyloles (C_8H_{10}), and ethylene gas (C_2H_4), with its homologues propylene (C_3H_6) and butylenes (C_4H_8). Marsh gas (CH_4) may practically be neglected as a direct illuminant, although its presence in gas increases the illuminating power of the heavier hydrocarbons.

CANDLE POWER
TOTAL C.P. PURIFIED GAS
C.P. DUE TO BENZOL AND ITS HOMOLOGUES
C.P. DUE TO ETHYLENE AND ITS HOMOLOGUES
HOURS COKING TIME.

FIG. 10.—CANDLE POWER OF COKE-OVEN GAS FROM DOMINION COAL.

The benzol produced by carbonizing bituminous coal goes almost entirely into the gas (90 to 95 per cent.)—only a small fraction going into the tar. According to Knublauch, 1 per cent. of benzol vapour in the gas is equivalent to about 10-candle power; and 1 per cent. of ethylene to about 1·67-candle power. If the candle power and the total illuminants in a gas are known, then the percentages of benzol and ethylene may approximately be calculated. From the figures given in Table XIII. we have computed Table XXI., in which the reduction of the illuminating value of the gas by 1 per cent. of carbonic acid has been assumed at 0·75-candle power. The data contained in this table are graphically illustrated in charts (fig. 10).

It will be seen that after the twenty-second hour the total candle power drops quite rapidly. These candle power figures, if taken in conjunction with the quantity of gas made during each hour, will produce the curves shown in the graphical chart (fig. 11). The candle power due to benzol, however, continues at a very much higher rate than that due to ethylene.

The actual results at Everett prove a still greater predominance of benzol than is shown in these curves, because the illuminating value of the poor gas can be almost entirely destroyed by scrubbing with tar oil.

TABLE XXI.—*Distribution of Illuminants in International Coal Gas.*

Based upon Glassport Estimate Sheets, No. 586.

Hours after Charging.	Gas Produced per gross Ton Dry Coal. Cub. Ft.	Analysis of Unpurified Gas.				Candle Power of Gas.		Candle Power of Gas freed of CO_2 due to		Candle Feet in Gas freed of CO_2 due to		
		CO_2	III.	C_6H_6	C_2H_4	With CO_2	No CO_2	C_6H_6	C_2H_4	C_6H_6	C_2H_4	Total.
1	413	3·9	5·8	1·4	4·4	18·4	21·3	13·9	7·4	5,741	3,056	8,797
2	333	3·8	5·8	1·4	4·4	18·4	21·2	13·8	7·4	4,595	2,464	7,059
	746									*10,336*	*5,520*	*15,856*
3	295	3·7	5·8	1·4	4·4	18·4	21·1	13 7	7·4	4,042	2,183	6,225
	1,041									*14,378*	*7,703*	*22,081*
4	312	4·2	5·7	1·2	4·5	16·2	19·4	11·8	7·6	3,682	2,371	6,053
	1,353									*18,420*	*10,074*	*28,138*
5	347	3·9	5·7	1·1	4·6	15·4	18·3	10·5	7·8	3,644	2,707	6,351
	1,700									*22,064*	*12,781*	*34,385*
6	357	3·7	5·4	1·0	4·4	14·4	17·2	9·8	7·4	3,499	2,642	6,141
	2,057									*25,563*	*15,423*	*40,526*
7	342	3·5	5·4	0·9	4·5	13·8	16·4	8·9	7·5	3,044	2,565	5,609
	2,399									*28,607*	*17,988*	*46,135*
8	350	3·4	5·2	1·0	4·2	14·5	17·1	10·1	7·0	3,535	2,450	5,985
	2,749									*32,142*	*20,438*	*52,120*
9	386	3·3	5·0	0·9	4·1	13·7	16·1	9·3	6·8	3,590	2,625	6,215
	3,135									*35,732*	*23,063*	*58,335*
10	344	3·2	4·9	0·9	4·0	13·3	15·7	9·0	6·7	3,096	2,305	5,401
	3,479									*38,828*	*25,368*	*63,736*
11	324	3·2	4·9	0·9	3·9	13·2	15·6	8·9	6·7	2,884	2,171	5,055
	3,803									*41,712*	*27,539*	*68,791*
12	362	3·3	4·8	0·9	3·6	13·2	15·7	9·2	6·5	3,330	2,353	5,683
	4,165									*45,042*	*29,892*	*74,474*
13	363	3·4	4·7	0·9	3·6	13 0	15·6	9·3	6·3	3,376	2,287	5,663
	4,528									*48,418*	*32,179*	*80,137*
14	357	3·5	4·5	0·9	3·5	12·3	14·9	8·8	6·1	2,966	2,056	5,022
	4,865									*51,384*	*34,235*	*85,159*
15	362	3·3	4·4	0·9	3·2	12·1	14·6	8·7	5·9	3,149	2,136	5,285
	5,227									*54,533*	*36,371*	*90,444*
16	364	3·3	4·1	0·9	2 9	11·9	14·4	9·0	5·4	3,276	1,966	5,242
	5,591									*57,809*	*38,337*	*95,686*
17	318	3·0	3·8	0·9	2·7	11·9	14 2	9·4	4·8	2,989	1,526	4,515
	5,909									*60,798*	*39,863*	*100,201*
18	360	3·2	3·7	1·0	2·6	11·8	14·2	9·6	5·6	3,416	2,016	5,472
	6,269									*64,254*	*41,879*	*105,673*
19	345	3·2	3·5	0·9	2·5	11·1	13·5	9·1	4·4	3,140	1,518	4,658
	6,614									*67,394*	*43,397*	*110,331*
20	330	3·0	3·4	0·9	2·3	10·6	12·9	8·6	4·3	2,838	1,419	4.257
	6,944									*70,232*	*44,816*	*114,588*
21	346	2·7	3·2	0·9	2·2	11·0	13·0	9·1	3·9	3,149	1,349	4,498
	7,290									*73,381*	*46,165*	*119,086*
22	344	2·5	3·1	0·9	1·9	10·8	12·7	9·0	3·7	3,096	1,273	4,369
	7,634									*76,477*	*47,438*	*123,455*
23	396	2·4	2·8	0·9	1·6	10·3	12·1	8·9	3·2	3,524	1,267	4,791
	8,030									*80,001*	*48,705*	*128,246*
24	378	2·2	2·5	0·9	1·1	10·3	12 0	9·3	2·7	3,515	1,021	4,536
	8,408									*83,516*	*49,726*	*132,782*
25	320	2·0	2·0	0·9	1·7	9·0	10·5	8·6	1·9	2,752	603	3,360
	8,728									*86,268*	*50,334*	*136,142*
26	294	1·8	1·5	0 8	0·7	7·8	9·2	8·0	1·2	2,353	353	2,705
	9,022									*88,620*	*50,687*	*138,847*
27	286	1·5	1·3	0 6	0·5	6·3	7·4	6·4	1·0	1,830	286	2,116
	9,308									*90,450*	*50,973*	*140,963*
28	275	1·3	1·0	0·5	0·3	4·5	5·5	4·6	0·9	1,265	248	1,513
	9,583									*91,715*	*51,221*	*142,476*
29	228	1·1	0·7	0·4	0·2	3·8	4·6	4·1	0·5	935	114	1,049
	9,811									*92,650*	*51,335*	*143,525*
30	163	0·8	0·6	0·4	0·2	3·7	4·3	3·9	0·4	655	67	722
	9,979									*93,305*	*51,402*	*144,247*
31	144	0·7	0·5	0·3	0·0	3·1	3·6	3·3	0·3	475	43	518
	10,123									*93,780*	*51,445*	*144,765*
32	127	0·8	0·4	0·4		3·6	4·2	4·0		508		
	10,250									*94,288*	*51,445*	*145,273*
33	94	1·0	0·4	0·4		3·5	4·3	4·0		376		
	10,344									*94,664*	*51,445*	*145,649*
34	46	1·3	0·2	0·2		2·5	3·5	2·0		92		
	10,390									*94,756*	*51,445*	*145,741*

Note.—1 per cent. C_6H_6 = 10-Candle Power : 1 per cent. C_2H_4 = 1·67-Candle Power.

At present, the actual results at the Everett coke-plant are as follows :—

	Candle Power.
Rich gas, freed of CO_2	18·5
Poor gas	9·5
Poor gas, if scrubbed by tar oil	0·7

This does not fully correspond with the data in Tables XII. and XIII. and figs. 10 and 11. But this is easily

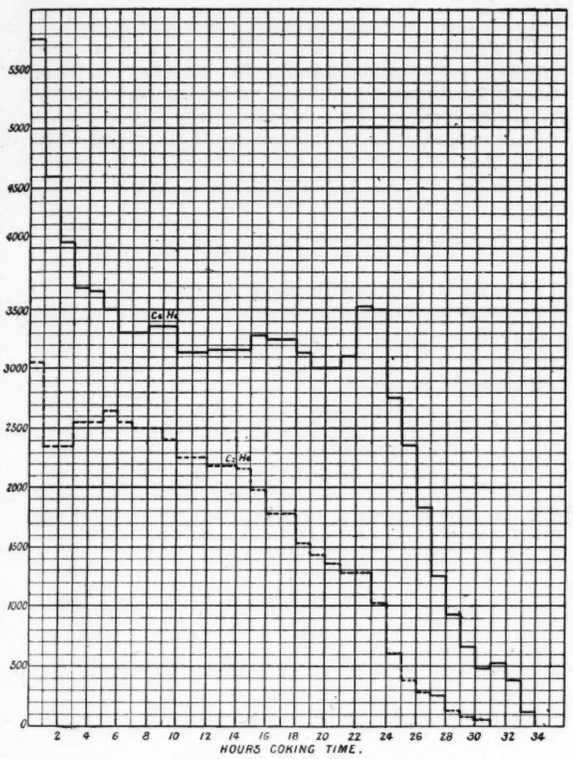


FIG. 11.—HOURLY ILLUMINATING VALUE (CANDLE-FEET) OF COKE-OVEN GAS FROM DOMINION COAL.

explained, because the charts are based on the calculations in which the two classes of illuminants are assumed to consist exclusively of benzol and ethylene. As a matter of fact, there are other additional hydrocarbons, homologues of both, produced, which somewhat change these illuminating values.

Furthermore, it is well known that the enriching value of hydrocarbons changes considerably with the initial illuminating value of the flame to be enriched. For instance, it takes less benzol to enrich a flame from 5 to 6 candle power than to enrich a flame from 20 to 21 candle power. Again, from the graphical chart fig. 7, showing the gas analyses, it becomes evident that the character of the gas changes constantly, which has a great influence on the enriching effect of the illuminants, because the various diluents require varying percentages of illuminants for the same increase in candle power.

The determination of the exact nature and percentual relation of the various illuminants produced during each hour of the coking process is very difficult; but I intend to make further investigations in this direction. In this connection, I wish to call attention to the opportunity which the fractional separation of the coke-oven gas affords me, of selecting such a mixture of the diluents as will produce a flame meeting modern requirements. With the ever-increasing use of the incandescent lamp, and the rapid growth of the fuel and power gas consumption, entirely new conditions confront the gas engineer. The admixture of blue water gas to certain fractions of the coke-oven gas, as suggested above, deserves serious consideration, on account of the great heat concentration in the carbon monoxide flame.

It will be impossible to enter just now more fully into all these highly interesting problems. The following table shows the great difference in the compositions of the diluents in the coke-oven gas during different stages of its production, based upon Tables XII. and XIII.

TABLE XXII.—*Diluents in Coke-Oven Gas.*

—	CH_4	H_2	CO.
Product of first hour	40·3	34·3	6·8
Product of last hour	9·6	66·7	6·4
Surplus gas, 5143 cubic feet per long ton coal	38·7	38·4	6·1
Oven-heating gas, 5247 cubic feet per long ton coal	29·2	50·5	6·3
Blue water gas (about)	1·0	40·0	51·0

The high percentage of marsh gas in the first gas is of especial interest.

BENZOL IN TAR.

As already mentioned, the bulk (from 90 to 95 per cent.) of the entire benzol produced by the destructive distillation of the coal is contained in the gas in vaporous form; while only from 5 to 10 per cent. goes into the tar. This latter amount is also available for enriching purposes in coke-works by flushing the gas-mains on top of the ovens in a systematic manner with those fractions of the tar which contain most of the benzol. The heating of the tar by contact with the hot, raw gas expels the benzol. Whatever then remains in the tar could also be transferred to the gas, if needed, by passing a part of the gas through the tar-stills, in case a tar-distilling plant is operated in connection with the coke-plant.

APPLICATION OF COKE-PLANTS TO THE GAS SUPPLY OF LARGE CITIES.

In order to show the quantities of gas to be produced by an auxiliary gas plant in connection with the coke-ovens, I will assume a situation similar to that existing in many of the manufacturing cities located in the North-eastern part of the United States. The maximum day is assumed at 5,500,000 cubic feet; and the minimum day at 2,500,000 cubic feet. The daily average for the year is nearly 3,800,000 cubic feet. The entire annual output would be 1,386,400,000 cubic feet in the gasholder at the coke-plant, equivalent to about 1,250,000,000 cubic feet sold to the consumers. Assuming an average consumption of 3000 cubic feet per head of population, this would be the requirements of a city of about 400,000 inhabitants. A plant of 100 of the new ovens, as described above, would supply such amount of gas.

Table XXIII. and graphical chart (fig. 12) will show the approximate fluctuation in the gas consumption, and the supply of the gas by the combined coke-oven and auxiliary gas plant. In this table, the increase in the gas output has been disregarded, which makes the curves for the first and second halves of the year practically the same; while in practice the second half of the year shows generally higher figures than those in the corresponding months of the first half.

The annual output would be produced as follows :—

	Cubic Feet.	Per Cent.
By coke-ovens	1,137,000,000	= 82
,, auxiliary gas plant	249,400,000	= 18
Total output	1,386,400,000	= 100

TABLE XXIII.—*Approximate Gas Consumption of a City of 400,000 Inhabitants Supplied by a Coke Plant.*

—	Average Daily Output. Cubic Feet.	Days in Month.	Total Monthly Output. Cubic Feet.	Coke-Oven Surplus Gas. Cubic Feet.	Difference to be Supplied by Auxiliary Gas Plant. Cubic Feet.	If Water Gas is used, then Mixture will Consist of	
						Per Cent. Coke-Oven Gas.	Per Cent. Water Gas.
Jan.	4,500,000	31	139,500,000	83,700,000	55,800,000	60·0	40·0
Feb.	4,200,000	28	117,600,000	89,600,000	28,000,000	76 2	23·8
Mar.	3,900,000	31	120,900,000	99,200,000	21,700,000	82·1	17·9
Apl.	3,600,000	30	108,000,000	96,000,000	12,000,000	88·8	11·2
May	3,400,000	31	105,400,000	99,200,000	6,200,000	94·1	5·9
June	3,200,000	30	96,000,000	96,000,000	—	100·0	0·0
July	3,200,000	31	99,200,000	99,200,000	—	100·0	0·0
Aug.	3,400,000	31	105,400,000	99,200,000	6,200,000	94·1	5·9
Sep.	3,600,000	30	108,000,000	96,000,000	12,000,000	88·8	11·2
Oct.	3,900,000	31	120,900,000	99,200,000	21,700,000	82·1	17·9
Nov.	4,200,000	30	126,000,000	96,000,000	30,000,000	76·2	23·8
Dec.	4,500,000	31	139,500,000	83,700,000	55,800,000	60·0	40·0
—	3,800,000	365	1,386,400,000	1,137,000,000	249,400,000	—	—

As described above, this auxiliary gas plant could be arranged in two different ways:

(*a*) *Auxiliary Producer Plant.*—The additional 249,400,000 cubic feet of gas would have about 625 B.H.U., as may

be found from Table XII. The producers operated in conjunction with the Everett coke plant show in practical operation an efficiency of 90 per cent.—*i.e.*, this percentage of the heat-value of the coke (13,280 B.H.U. per pound, according to the Dulong-Mahler formula) is recovered in the form of additional coke-oven gas. Consequently, the amount of coke required per year for the producers would be as follows:—

$$\frac{249{,}400{,}000 \times 625}{13{,}280 \times 0{\cdot}90 \times 2000} = 6363 \text{ net tons,}$$

or only about 3 per cent. of the annual coke production of the plant of 219,000 net tons.

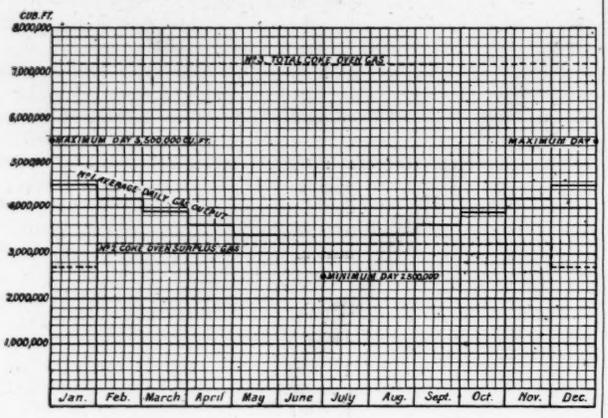


FIG. 12.—DIAGRAM SHOWING THE APPROXIMATE GAS CONSUMPTION OF A CITY OF 400,000 INHABITANTS, SUPPLIED BY A COKE PLANT.

The illuminating gas would be an unmixed coke-oven gas, with but small variations in its analysis. The minimum gas output in June and July (see Table XXIII. and graphical chart fig. 12) would correspond with a gas surplus of 4000 cubic feet per net ton of coal. During these months the producers would be idle. For the December output, the surplus gas would have to be increased by means of producer firing to $\frac{4{,}500{,}000}{3{,}200{,}000} \times 4000 = 5625$ cubic feet per net ton of coal; and for the maximum daily gas output to $\frac{5{,}500{,}000}{3{,}200{,}000} \times 4000 = 6875$ cubic feet per net ton of coal. The analyses of the gas for these periods can then be easily determined from Table XIII. (bearing in mind the difference between long and net tons) as follows:—

TABLE XXIV.—*Changes in Gas Analysis due to Increase of Gas Output by Producers.*

—	June & July.	Dec. & Jan.	Day of Maximum Output.
Illuminants (C_mH_n)	5·3	4·8*	4·7*
Marsh gas (CH_4)	39·1	37·9	37·4
Hydrogen (H_2)	37·9	39·4	40·1
Carbon monoxide (CO)	6·1	6·2	6·2
Carbon dioxide (CO_2)	3·6	3·5	3·4
Oxygen (O_2)	0·3	0·3	0·3
Nitrogen (N_2)	7·7	7·9	7·9
	100·0	100·0	100·0
Calorific value . . . . B.H.U.	690	676	667

* These percentages would be slightly increased on account of the addition of the benzol vapours.

The character of the gas sent out during the winter is, therefore, almost identical with that of the summer gas. At any rate, the difference in composition is insignificant. The illuminating value of the rich gas can be constantly maintained at 23-candle power, as will be seen from the following calculations:—

TABLE XXV.—*Illuminating Value of Coke-Oven Gas, per Net Ton of Coal.*

	Quantity. Cb. Ft.	Candle Power, free of CO_2	Illuminating Value. Candle-Feet.
Rich gas purified .	4,000	.. 18·5	.. 74,000
Poor gas ,, . .	5,000	.. 9·5	.. 47,500
Total gas purified .	9,000	.. 13·5	.. 121·500

It may be said that the total yield of 121,500 candle feet is to be considered a high one, as it represents the results from a coking coal. The ordinary gas-retort, from crude gas coals, obtains about 9500 cubic feet of 17-candle power gas from good gas coals, which is 101,500 candle feet.

Returning to the Everett results, the poor gas shows a total of 47,500 candle feet when washed with tar oil. This can be reduced to 0·7-candle power; leaving in the poor gas $5000 \times 0{\cdot}7 = 3500$ candle feet. In other words, the removed illuminants in the poor gas are equivalent to 44,000 candle feet per net ton of coal. There may be a slight loss connected with the transfer of these illuminants to the rich gas; and, furthermore, when introduced into a gas of high candle power, they will not have the same efficiency as in a low candle power gas. At any rate, we shall be safe in assuming that these illuminants, when transferred into the rich gas, will have an efficiency of 80 per cent. of that in the poor gas. Consequently, $44{,}000 \times 0{\cdot}8 = 36{,}200$ candle feet would represent the illuminating value available for the enrichment of the surplus gas. We would have, therefore, the following conditions:—

	Candle-Feet.
Illuminating value of 4000 cub. ft. of rich gas =	74,000
Illuminating value obtainable from poor gas =	36,200
Total illuminating value per net ton of coal	110,200

A plant of 100 coke-ovens has a carbonizing capacity of 292,400 net tons of coal. Consequently, the candle power of the entire gas production of 1,386,400,000 cubic feet would be as follows:—

$$\frac{292{,}400 \times 110{,}200}{1{,}386{,}400{,}000} = 23{\cdot}2\text{-candle power.}$$

This is considerably in excess of the requirements for ordinary coal gas. If the gas sent out would have only 20-candle power, then a considerable amount of benzol would be available.

For the enriching value of 1 gallon of benzol, various figures have been given by different investigators. This is undoubtedly due to the fact of the influence of the diluents. The general opinion among German gas men is that 3 grammes of benzol enrich 1 cubic metre of gas 1 Hefner candle on the consumption of 150 litres per hour. This is equivalent to a consumption of 0·025 gallon of benzol per 1000 cubic feet for 1-candle power. In other words, a gallon of benzol is equivalent to 40,000 candle feet. As, however, the enriching in our case would be done on a high initial candle power, we will assume the enriching value of 1 gallon of benzol at only 30,000 candle feet. Then the amount of benzol which could be condensed and sold per year, if a gas of only 20-candle power instead of 23·2-candle power were to be sent out, is as follows:—

$$\frac{1{,}386{,}400{,}000 \times 3{\cdot}2}{30{,}000} = 147{,}883 \text{ Winchester gallons.}$$

The present London price of 90 per cent. benzol is 9·5d. per Imperial gallon.

(*b*) *Auxiliary Water-Gas Plant.*—The general description of such a plant, in connection with the coke-ovens, has been given before. Three different ways of operating a water-gas plant suggest themselves—

(1) As ordinary producers. In this instance, the proposition would be exactly the same as just discussed.

(2) As a carburetted water-gas plant. The mixing of carburetted water gas with coal gas has become such common practice now that it is not necessary to further discuss this combination. It is evident that the addition of a water-gas plant with an oil storage would ensure a continuous supply of gas to the city, and would, consequently, form a welcome reserve in case of strikes, accidents, &c.

In this connection, it may be mentioned, however, that a coke plant has great advantages over the ordinary gas-retort, in its readiness to supply a very large amount of gas on short notice, because it is only necessary to turn more coke-oven gas into the rich-gas main. A reduced amount of heating gas for a short period of time will have no serious effect on the oven heats, on account of the large regenerator attached. When the emergency has passed, the oven heats can be brought back without difficulty.

(3) As a combined blue water gas and producer plant. As described above, this method of operating would provide for the combustion under the ovens of the producer gas coming from the generator, while the blue water gas would be mixed with the coke-oven gas. The amount of heat available in the producer gas is quite considerable; and, consequently, a perceptible amount of additional coal gas released from the ovens. For simplicity's sake, we will

assume that the entire gas increase is to be obtained by the admixture of blue water gas. On that basis, we would have the following conditions: The coke consumption for 1000 cubic feet of blue water gas made by the Dellwik-Fleischer process would amount not in excess of 35 lbs. The annual gas deficiency to be made up by the auxiliary plant is 249,400,000 cubic feet, requiring therefore the gasification of 4365 net tons of coke (as compared with 6363 net tons in the producers).

The admixture of the water gas would materially alter the character of the gas sent out in winter time, as is evident from the following table :—

TABLE XXVI.—*Changes in Gas Analysis due to Increase of Gas Output by the Addition of Blue-Water Gas.*

—	Blue Water Gas.	June and July 100 p. c. Coke-Oven Gas.	Dec. and Jan. 71 p.c Coke-Oven Gas. 29 p.c. Blue Water Gas.	Maximum Day 58 p.c. Coke-Oven Gas. 42 p.c. Blue Water Gas.
Illuminants (C_mH_n) .	..	5·3	3·8*	3·1*
Marsh gas (CH_4) . .	1·0	39·1	28 1	23·1
Hydrogen (H_2) . . .	51·0	37·9	41·7	43·4
Carbon monoxide (CO)	40·0	6·1	15·9	20·3
Carbon dioxide (CO_2) .	4·5	3·6	3·9	4·0
Oxygen (O_2). . . .	..	0·3	0·2	0·2
Nitrogen (N_2) . . .	3·5	7·7	6·4	5·9
	100·0	100·0	100·0	100·0
Calorific value B.H.U.	323	690	584	536

* These percentages would be slightly increased on account of the addition of the benzol vapours.

The difference in the calorific value between summer and winter gas is very great. The character of the gas-flame would show a considerable difference, on account of the varying percentage of carbon monoxide.

The admixture of the blue water gas may reduce the cost of purification considerably. The larger percentage of sulphur compounds is contained in the rich gas; and if the percentage of sulphur in the coal is high (say, 2 to 2½ per cent.), then the "organic" sulphur in the rich gas would exceed the statutory limit of 20 grains for 100 cubic feet. This would necessitate the expensive removal of the carbon dioxide (the bulk of which is also contained in the first rich gas), in order to make possible the removal of the carbon bisulphide by means of sulphided lime.

The calculations given for the enriching of the additional gas recovered by producers, apply also to the increase of the gas output by the admixture of blue water gas. It should be understood that the producer auxiliary would have a slight advantage over the blue water-gas attachment for two reasons, which have been disregarded in the previous calculations—viz., first, the candle power due to the ethylene in the additional coke-oven gas recovered by producer gas has not been taken into consideration; and, secondly, the producer auxiliary furnished additional coke-oven gas only, which consequently contains more marsh gas and less carbon monoxide and hydrogen than the mixture of coke-oven gas and blue water gas (see Tables XXIV. and XXVI.). Marsh gas, however, as a diluent, produces a higher candle power from the same amount of illuminants than carbon monoxide (*vide* the experiments of Dr. Percy Frankland).

COMMERCIAL RESULTS OF COKE-OVEN GAS PLANTS.

The rapid increase in the number of bye-product coke-ovens built in the United States is ample proof that, from a commercial point of view, they are a good investment. It is impossible to give an operating statement which will apply to all conditions, as the same will vary with every city. We shall, however, enumerate the items which will enter into the actual operating balance, and give sufficient indication to enable the results to be computed for any particular condition.

TABLE XXVII.—*Operating Results of a Plant of 100 Coke-Ovens and Gas Plant.*

	Net Tons.
Annual expenditure—	
(1) *Coal.*—I base this estimate on average coking coal. The plant carbonizes 800 net tons of coal a day, or per year .	292,000
(2) *Wages, Materials, and Maintenance.*—All these operating expenses depend on the local scale of wages and cost of materials. The total may be estimated at 30c. to 50c. per net ton of coal carbonized, for which sum the coal is taken from a vessel or railroad car, the coke delivered on the cars, and the tar is delivered in a storage tank. The gas liquor is manufactured into concentrated ammoniacal liquor or sulphate of ammonia, and the illuminating gas is delivered into the gasholder.	
(3) *Gas Auxiliary Expenses.*—The increased demand of the winter months would be satisfied by means of a producer plant, which would consume of coke . . . . . The operating expenses, wages, and materials for these producers would amount to about 25 c. to 40 c. per ton of coke gasified. An auxiliary blue water-gas plant, as described above, would entail approximately the same expense.	6,363
(4) *General Expenses.*	
(5) *Interest and Depreciation.*—The cost of the plant depends greatly on the location.	
Annual receipts—	
(6) *Coke* (75 per cent.).—600 net tons per day are equal per year to . . . . . The value of the coke will depend upon the demand for the same. Metallurgical and foundry coke generally command a better price than domestic fuel.	219,000
(7) *Tar* (5 per cent.) is equal to . . . . . The same is worth at present in London 14s. 6d. to 17s. 6d.	14,600
(8) *Ammonia* (1 per cent.) calculated as sulphate . . . . The same is quoted at present in Liverpool £10 12s. 6d. From the sales price, the cost of the sulphuric acid should, however, be deducted, when manufacturing sulphate. One pound of sulphate requires approximately 1 pound of 60° (Beaumé) sulphuric acid.	2,920
(9) *Additional Bye-Products* (cyanides, light hydrocarbons, sulphur) may be recovered. The market price for these products varies greatly.	
	Cubic Feet.
(10) *Gas.*—The gas sold to consumers, after taking into consideration the leakage, &c., will amount per year to . . The value of the gas in the holder varies according to local conditions within wide limits.	1,250,000,000

I hope to have proved that the bye-product coke-oven will require serious consideration in the solution of the smoke problem. Apart from this, it commands attention on account of its extensive use in the blast-furnace industry. Heretofore, the coke-oven surplus gas has been used under boilers. By adopting the improvements described above, gas of excellent quality can be obtained and made available for the supply of large cities. Such a plant would form a central station to supply light, heat, and power. Considering the three requirements, I find the following :—

(1) *Light.*—The gas is of high candle power and, at the same time, of high calorific value; so that it can be used to advantage in an open flame or in the incandescent lamp. Wherever electric light for isolated plants is preferred, it could be very cheaply produced by gas-engines.

(2) *Heat.*—The high calorific value makes the rich coke-oven gas the best artificial fuel gas for domestic and small manufacturing purposes. Wherever solid fuel is required, coke can be used to better advantage than any other fuel. Its only disadvantage, as compared with anthracite and bituminous coal, is its greater bulk. The smoke and cinder problem would find a satisfactory solution. Tar may also be mentioned as a possible liquid fuel, to be used with advantage for special purposes.

(3) *Power.*—For small units, the gas-engine is destined to replace the steam-engine. If the peculiar requirements of the case make electrical power preferable, the gas-engine can produce the same most economically. For larger units, the coke could be gasified, and larger gas-engines employed. Wherever a change to the more economical gas-engine is impossible, and boilers cannot be replaced, coke can be used with great success as fuel.

All that has been stated is now corroborated by the results of plants in the United States, operated on the largest scale. When the first discussions on this subject were brought before the public, they were received with a great deal of scepticism. The advocates of the bye-product coke-ovens were considered as people who travel into far-away countries *avant d'être partis*. This industry has found a solid footing in the United States; and several colossal plants are under contemplation.

In closing, I deem it my duty to gratefully acknowledge the munificence of the United Coke and Gas Company and the New England Gas and Coke Company, the Presidents of which Companies have made these investigations possible by their financial aid.

All engineers interested in this subject are cordially invited to visit any of the plants erected in the United States and Canada.

Discussion.

Mr. LIVESEY said that (not being the Chairman at the moment) he was free, and the only remark he wished to make, in opening the discussion, was to express the warm thanks of all of them to the author and to Dr. Révay for their great kindness in supplying them with this most interesting paper.

It seemed to him that everything was tending in the direction of the production of gas in a different form. They had gone on for 100 years with the same form of production as when gas making was first started, at the beginning of the last century. At the commencement of this century, it seemed to him that they must seek a new departure; and a paper like the one read would be a very great help in that direction. He should not take up more of their time; but he knew they would all wish to second what he proposed—that they should thank their friends most heartily for their kindness in assisting them as they had done with this paper.

Mr. FOULIS (who occupied the chair) said he thought, with Mr. Livesey, that this was a paper of very great interest, and one on which several of the members would have some remarks to make. They would be very glad to hear anything which anyone might have to say upon it.

Mr. S. O. STEPHENSON (Tipton) said he saw that the author stated that he obtained 9000 cubic feet of gas per ton of coal from his coke-oven. It would be interesting to know what the same coal would give in the ordinary way—if carbonized in retorts. He presumed there was a loss of about 1000 cubic feet per ton in carbonizing in this way. Of course, against that they got a larger value in residuals, which was a great point for consideration. But they were not entirely makers of residuals; their purpose was more the manufacture of gas than residuals. This brought him to another point. The method of heating the ovens, as stated in the paper, was by a portion of the gas made. He thought they would hardly care to do that.

Mr. FOULIS said the whole idea was to make the gas a residual; the main object was the value of the coke.

Mr. STEPHENSON: And make the gas as a residual?

Dr. RÉVAY: That was the original idea. The coke-oven is wanted to fulfil a mission—to replace gas-works, and, at the same time, to make good coke.

Mr. STEPHENSON said he thought there was no reason, all the same, why the process should not be applicable to gas-works in this country. He thought they might get their 20s. per ton for the coke-oven coke, which was, he believed, its present value. Rather than use a portion of the gas for heating the oven, they might buy the coke from neighbouring works, where they were not going in for the process, at (say) 8s. 6d. per ton, as it was being sold at at the present time; and it would be a paying speculation. Of course, if it were successful, many more would be found going in for these plants; and the value of the coke would go down considerably, and bring them back to use coke-oven coke in the ordinary way for heating the plant and making the gas. Still, he thought that this oven was a good idea for producing gas; and it would be interesting to see the experiment tried in this country. He would like to know if the reader of the paper could furnish them with information as to the value of the coal when carbonized in ordinary coal-gas retorts, as against the 9000 cubic feet given in the paper.

Mr. CHARLES HUNT (Birmingham) said that, dealing first with the concluding words of the paper, it would be very gratifying if they could accept the invitation to visit these works in America in the near future. He thought he was the first to bring this subject before gas makers—the idea of supplementing gas-works plant by means of coke-ovens, instead of ordinary retorts; and he brought before the Institution of Gas Engineers, in 1895 or 1896, the results of certain experiments which he had made with the Semet-Solvay coke-ovens, as used by the Brymbo Steel Company in North Wales. When he first commenced inquiring into the subject, he was told that, for lighting, the gas was practically good for nothing. But, on analysis, he found that it ought to be good for something, if only the process of manufacture were carefully attended to; and he suggested the very simple remedy of attending to the exhauster. When this was done, the results were practically the same as those which were obtained in an ordinary coal-gas retort. He did not think that the yield was quite so great; but this might be owing to the fact that nothing but slack was used. Of course, in this country it was necessary to wash most of the slack that was used, and also to grind it. Nothing was mentioned in the paper with regard to these processes, and that was a drawback. He never anticipated that there would be such a rapid development of this matter; and the author had dealt with it in a manner that he should never have thought it was capable of. They could all agree with what he said in commencing the paper—as to the desirability of a more extended use of smokeless fuel; for they were makers of smokeless fuel, and the only difference between the process described and the one they followed, was a matter of comparative cost. The question was, whether this system could be used as an auxiliary to their present plant in centres of industry where the oven coke was of particular importance. He did not go further than this, nor did he suggest that, as the recovery process was being so extended to all metallurgical processes, and as the effect of this must be to bring down the cost of residuals, they ought to do what they could to meet it by adopting the process where possible, so as to limit the production of residuals. Already they found that the German methods of recovery ovens had greatly, and perhaps permanently, reduced the cost of many of their bye-products; and it was with the object, chiefly, of drawing attention to this that he brought the matter before the members some years ago. He still thought that there was a considerable future before the process for adoption in this country. But one of the problems which, it appeared to him, had to be solved before it was capable of adoption, was that of heating the ovens by some other means than by a portion of the gas produced. The author laid stress upon the desirability of separating the gases into rich and poor. Well, they had already got beyond that in this country. They were not going to separate gas; they were not going to enrich any more than they could help in the future. They wanted to get all the gas they could out of the coal, and to heat their retorts or ovens with some inferior fuel. The author did mention that an experiment of this kind had been tried; and he thought they should be grateful to the reader of the paper if he could give them further information in regard to this. It had been hitherto the chief stumbling-block to any experiments in this direction in this country; and if he could furnish them with some data upon which to proceed, he thought it would be an advantage to them. He was sure they were indebted to the author for a very interesting paper.

Mr. JAMES BARROW (Llynvi Gas Company) said he had to apologize on rising to address the meeting. He was an old gas maker, and was also an old gas and coke maker; and it was curious he should have come into the room at this particular time, when the paper was being read. In 1899, he was in Nova Scotia; he had been in the very works that were shown on the diagram, and he could assure the members that the diagram was a very clear representation of the exact works described. The works were not actually producing coke when he was there; but the fires were in the coke-ovens, the whole of the process was ready, and the engines were running. The author ought to explain that the object of producing two qualities of gas was this—that the conditions of life in the United States and this country were very different. In the United States during the winter season there was extreme cold; and on account of this they heated all the houses—every house, it did not matter, rich or poor. It was a necessity that it be heated up to a certain temperature, to get what they might call ordinary comfort for the family. The result was that the cottages even were built with a stove in the basement, and the hot air was allowed to pass up through the premises, and so keep it in a warm condition. Instead of each house having its own furnace in the basement, it was suggested by Mr. Everett and the Company of which he was the promoter and pioneer, that gas could be utilized, and conveyed to the houses just the same as ordinary lighting gas for heating purposes through street mains. It would not only effect economy, but be a great comfort; and they would also get a ready-money sale, which brought it home, as a commercial transaction, immediately. Indeed, he might say that it was part of the process that the ovens were arranged so that, in the first part of the process, the gas was taken off for lighting purposes, and then the second part was sent into a large holder and was used for heating. The gas for heating purposes was distributed to the city at different times of the day, according to the varying requirements of the city. There was an enormous population within three or four miles of Boston, where these works were. The gas was conveyed in suitable mains to the out-districts of the city. There was another feature which should present the process as an advantage in this country—that was, the disposal of the coke. If they were making coke of this particular class to the extent of 1000 tons per day, he feared it would be matter of very considerable difficulty to get a suitable market for it; but in that special instance, it happened that Mr. Everett was a Director of the Tramway Company, and of various Railway and Steam Shipping Companies. In this way, they found an outlet for the coke and other bye-products,

which met with a ready market in the enormous territories they controlled. It was part of his mission, when he was sent out, to find coal for these very ovens in Nova Scotia and Cape Breton, and collieries had been developed in New Sydney. He had no hesitation in saying that they could produce coal six or seven hundred miles away, and deliver it at Everett at a less cost than coal was being produced at in this country. This might seem a remarkable and a very bold saying; but he could assure them that coal was produced and put f.o.b. on barges—holding 500 tons—at something under $1 a ton. He had been a coal producer himself; and in his early days he produced coal at $1 per ton, and had sold it at 4s. 6d., and so was able to make 6d. per ton profit. But to-day he could not produce coal at double, and in some cases three times, the price; and the profit was *nil*. Now this was the exact position of things. As a producer of coal, he would like to point out the very serious position that this country was in. Some people pooh-poohed it, and said that Americans could not compete with them in this country; but he could assure them that there never was a greater mistake committed by man. He asked them to go to the Canadian Department of the Exhibition in the adjoining grounds, and look at the sections of coal that were on view—practical sections showing the exact condition of things to be got there to-day. The collieries that he instigated the opening up of did not cost £10 to open up the level, and they were now working 500 or 600 tons a day. He could illustrate another case, where the levels had been opened at a cost of £10 apiece, and they were working 1500 tons a day. If they could establish a business with so little capital as that, it must be apparent to them that the profits made from such an undertaking would be simply fabulous. There was no limit to the question of profit; it was a question of development. And they had developed these enormous concerns out of earnings which had been going on day by day and year by year. What had enabled them to do it? In this way, that they had a magnificent article to produce. And it had been produced at an exceptionally cheap rate; and they were now, in the cities, getting an enormous population, which was giving them a ready market for their products. In addition to this, the Government of the United States had not been content with ordinary commercial business, but had put on an enormous tariff, which had been a detriment to this country, and the tariff, though it was a tax on the multitude of the people, was a great benefit to individual producers. It was in this way that this particular department had, he might say, outgrown anything they had in this country. These were exact facts. He had not spent a whole lifetime, working in every State in various capacities, without observation. Though he was interested in the Mining Section, he had had very great pleasure in attending the meeting and hearing the paper read.

Mr. W. R. Herring (Edinburgh) was afraid it would be difficult for him to say very much on a question of this character. Unfortunately, he had not been able to peruse the paper. He thought it was a paper for after-study. But they might congratulate the author on presenting so many important facts to them. Perhaps there was just one point which did catch his fancy. When the reader was describing the tracing on the diagram, he noticed that he introduced combustion chambers for burning the gas beneath the oven. In his experience, he had found it to be rather a disadvantage to have a combustion chamber, in the ordinary sense of the word, there. He did not follow the diagram very closely, and he would like to know whether it was merely a large chamber in which gas and air were allowed to commingle, or whether it was a channel wherein the gases were allowed to ignite as a flame. With retort-settings and so on, personally, he had found that to put in a chamber where the gases were allowed to commingle in a large area was unnecessary, and a weakness to the structure.

Mr. Barrow said the chief objects in the construction of the oven were economy, and also the getting of the very largest production of coke possible from the coal they were using. He put it to them: What was the cheapest article they could use for heating the oven to a certain temperature? They could not, he ventured to suggest, use a heating power which could be compared with the gas that was produced by itself. It was not only the enormous temperature they got, but it was also clean, and it would continue, day by day, besides which it could be regulated to a nicety. This was the chief reason that gas was used for fuel.

Mr. W. W. Hutchinson (Barnsley) said he would like to ask whether the author found it was necessary to prepare the coke in any way for domestic purposes. He found that the large quantity of 25 per cent. of the total output was consumed in this manner. Of course, the previous speaker had partly answered his question; and he apprehended the reply would be that in America they used it in stoves, instead of in open fire-places as in England. He would also like to ask—the author had given no information upon the point—as to the capital cost per ton of coal carbonized per 24 hours, compared with ordinary gas-works practice.

Mr. Foulis said that, if there were no other remarks to be made, he thought he might ask Dr. Révay to reply. He could only say that this subject was a matter which well deserved the careful consideration of gas engineers. As Mr. Livesey remarked, they had been going on making gas in exactly the same way for the last 100 years; and this seemed to be a new departure, and one which, he thought, was well worthy of consideration. Practically, it was the manufacture, or rather the distillation, of coal in bulk. The question of whether a portion of the gas should be utilized for heating the retorts, or whether the retorts should be heated in some other way, was a mere matter of detail. It would require to be dealt with under each different circumstance. The whole gas, he supposed, would have an illuminating power of, probably, 14 or 15 candles; and the question of whether they should use a portion of the gas for heating retorts, or whether they were to use coke, depended very largely upon the sale they had for coke. He thought he remembered seeing that—at Boulogne, he fancied it was—where coke was very valuable, they were actually taking the gas from the coal-retorts, and heating the settings with it. So that the question of the fuel to be used was entirely a matter for the particular position of each works. He certainly thought the whole paper was one deserving of all consideration; and he was sure they were very much indebted to the author and to Dr. Révay for the paper.

Dr. Révay said he had to acknowledge, in the name of the author, the kind way in which they had received the paper, and briefly to reply to the questions put before them, especially by Mr. Stephenson, in regard to the heating of the ovens by a portion of the gas. He would point out that it was only the very poor gas that was used, as the rich gas was taken off in the first instance for lighting. The gas which was used in the coke-ovens was deprived altogether of its illuminating power. He had not at hand the particulars which would enable them to make comparisons between ordinary gas-retorts and coke-ovens; but he might point out that it was quite obvious that the results were in favour of the coke-oven in every respect. He would be pleased to give Mr. Stephenson the exact data on this subject. Mr. Hunt had put a question about the washing and grinding of the coal, and said there was no mention made in the paper about it. He was sorry to say that he had had to shorten the paper; but in it these words appeared: "The washing of the coal will reduce the percentage of oxide of iron in the Dominion coal ash." Of course, the coal was washed in one sense; but most qualities of American coal did not need any washing at all. With regard to grinding, it depended much upon whether they desired to obtain denser coke, or coke of a coarser grain. Mr. Barrow mentioned the want of a market for the coke in the United Kingdom. That market was not formerly in existence in the States; they had to create the market, and he did not see there could be any difficulty in creating one here either. The railway companies would have some remonstrances in the beginning; but they would come to use it, if it was their desire to have a smokeless fuel. Technical difficulties had to be overcome in the initial stage; and they had succeeded in the United States. As for domestic use, he might say that now nearly everyone in Boston used coke. He might reply to another question by saying that the coke was prepared—it was broken into small pieces, and into different sizes to suit different purposes. The big furnaces in the basement of the houses—heating furnaces—had become the fashion in this country too. He saw all over the United Kingdom the adoption of so-called American ideas; so he did not doubt that in a few years there would be a demand in the market for this description of coke. Mr. Herring put a question concerning the combustion chamber. He was sure he misunderstood his explanation, as there could be no question of a combustion chamber. It was simply a flue.

Mr. Herring: It is a narrow passage really. What is its width?

Dr. Révay said that it was usually about 17 inches wide.

Mr. Hutchinson asked the cost of production. That certainly differed very much, varying according to local circumstances, and also according to the capacity of the plant itself, and how far they recovered the bye-products. He had not much more to add to these questions. He should be pleased to give several tables, showing the objects and the calculations, from a commercial point of view, of the matter, and to place them at disposal for publishing with the paper.

THE PRINCIPLES OF CONSTRUCTION OF A PROPOSED MODERN GASHOLDER FOR AMSTERDAM.

By J. Van Rossum du Chattel, of Amsterdam.

[A Paper read before the Gas Section of the Engineering Congress at Glasgow.]

The conditions given for the construction of the holder were the following :—

The capacity of the holder (to be erected on a very poor subsoil) should be 100,000 cubic metres, or about 3½ million cubic feet. Piles must be used to give the necessary stability. The diameter must be 60 metres, or 200 feet, more or less.

The piles must bear a maximum weight of 10 tons each ; their normal length being 14 metres. The water-level is 1½ metres below the level of the ground, where the holder is to be built.

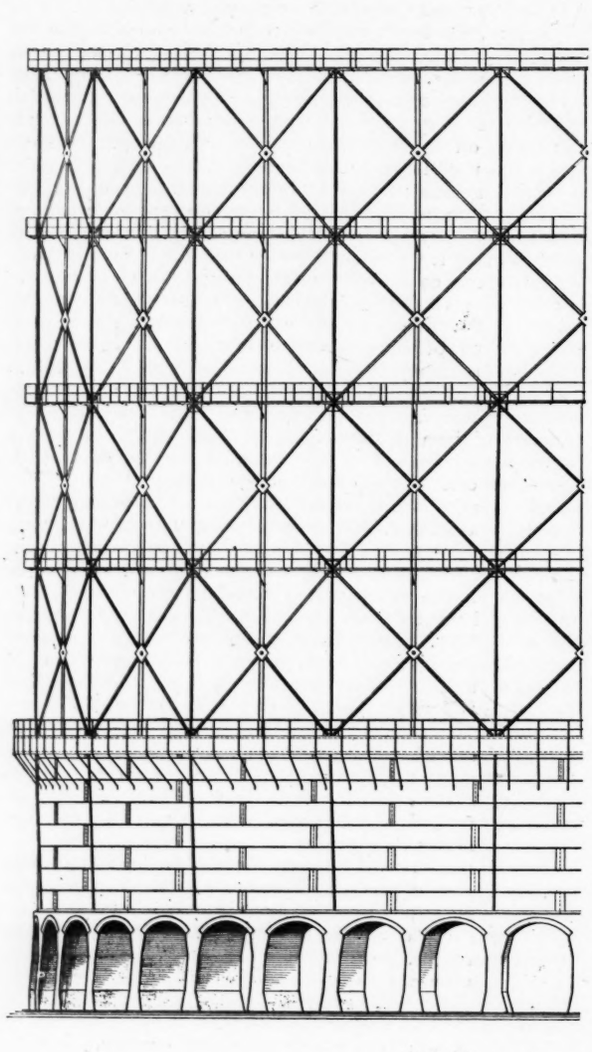
The indifferent nature of the ground, and the high cost of a good foundation, make it necessary to reduce as much as possible the total weight, and to exclude a tank made of brickwork or concrete.

Only a wrought-iron or steel tank containing a minimum weight of water could therefore solve the problem. An ordinary tank with a flat bottom for a four-lift holder, with a diameter of about 60 metres, would contain 29,000 tons of water ; and the holder weighing about 2000 tons, would give a total weight of 31,000 tons. This shows that, with regard to economy in weight, it was necessary to take into consideration the weight of the water.

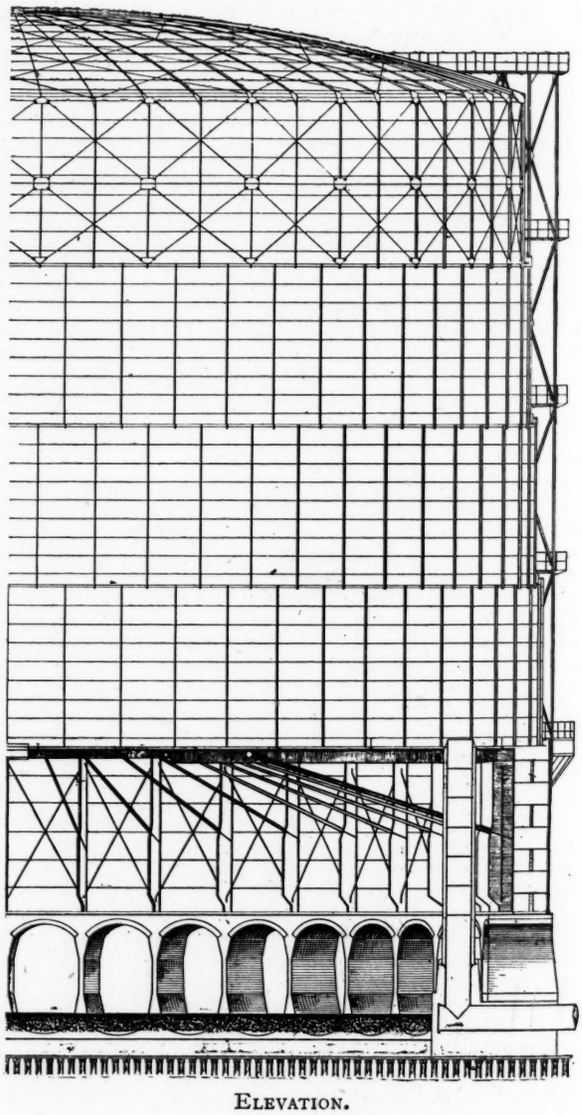
These difficulties, it was thought, could be met by the construction of a tank after the patent of Professor Intze, or by an annular tank above the ground. For the latter construction, less material is required ; and consequently it is cheaper, and more desirable from a general point of view. Care, of course, must be taken that no gas can enter into the interior space of the tank, which is intended to be used as a store-room. It is therefore necessary that the inner roof of the tank, or the intervening central space, should be covered with water. The inlet and outlet pipes are also covered by water for this reason. In order to make this large store-room fit for heavy materials, it was so arranged that a railway could pass through it—that is to say, so that a locomotive and train could pass under the tank and the walls ; the door-openings being made sufficiently high.

This being, so far as I know, the largest annular tank ever constructed under these conditions, and taking into consideration also the character of the soil and the vibrations induced by trains passing under the tank, extraordinary

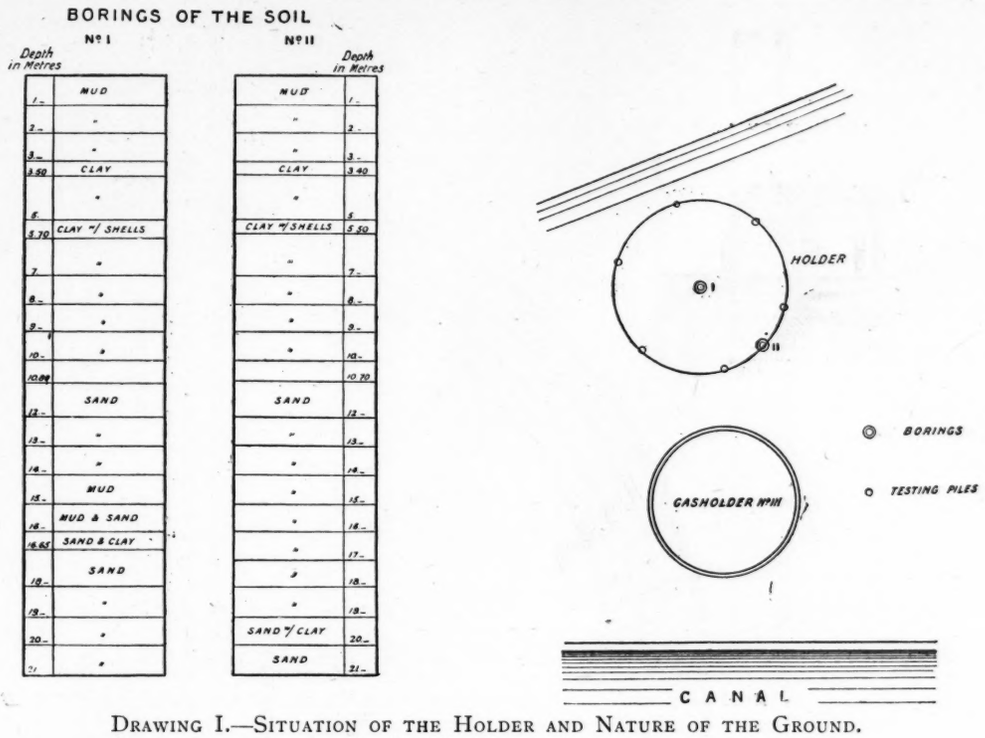
The Amsterdam Holder.—100,000 Cubic Metres Capacity.



Section.



Elevation.



Drawing I.—Situation of the Holder and Nature of the Ground.

care was required to thoroughly carry out the necessary static and elastic calculations for the tank. The calculations are, therefore, made on the supposition that, on account of the subsoil, the tank will sink at one side 20 centimetres, or about 8 inches. This supposition, of course, made the calculations complicated; and, in order to compute exactly the strains in all parts of the tank, the theory of Betti-Maxwell with elastic deformations must be applied.

Great care was taken with regard to the foundation. The character of the ground was thoroughly tested by boring and driving in testing-piles. (See Drawing No. I.) The testing-piles clearly proved that the subsoil was of a varying character, and that the length of the piles at different places must range between 40 and 60 feet. On the piles which are below the lowest water-level, a bed of concrete with old iron rails is built. The whole foundation is shown in Drawing No. II.

The wall on which the tank is to be erected will be made so that forty door-openings are ready to receive the train. Moreover, these walls, instead of being made as thick as required by a low stress, will be made of superior brickwork, with the best bricks set in portland cement, so that a higher stress may be allowed. The calculations are for a wind pressure of 250 kilogrammes per square metre; and maximum lateral strain on the bricks 15 kilos. per square centimetre. The piles will bear a maximum weight of 7000 kilos. each. The advantage is that a thinner construction of the walls may be allowed, and they are quite able to support the small pressures that may come upon them. All the arches of the foundation are in complete equilibrium, and through all the forty openings the train may pass. If the tank sinks on one side more than 8 inches, means are provided to put it straight again with wedges by screwing; and these, it is clear, may also be used for a sinking of less than 8 inches. It is hoped that their use will not be required; and it may be said in passing that the foundation is made so strong that there is little fear such will be the case.

In order to render a turn-table, with radial rails, possible in the centre of the store-room under the tank, so that the waggons may be discharged in all directions, it was desirable not to have any support under the tank, and no centre pier. This problem was rather a difficult one to solve; but a very ingenious way of surmounting the difficulty was found by Professor Barkhausen. Instead of covering the intervening central space or roof of the tank with a few inches of water, a larger quantity was used—40 centimetres, or about 16 inches, depth of water resting on the cover. The weight of this water gives compound stresses on the forty oblique struts, and from these on the forty vertical stays of the inner mantle of the tank, by means of which additional strength is given to meet the pressure of the water in the annular tank, so that a much lighter construction will suffice.

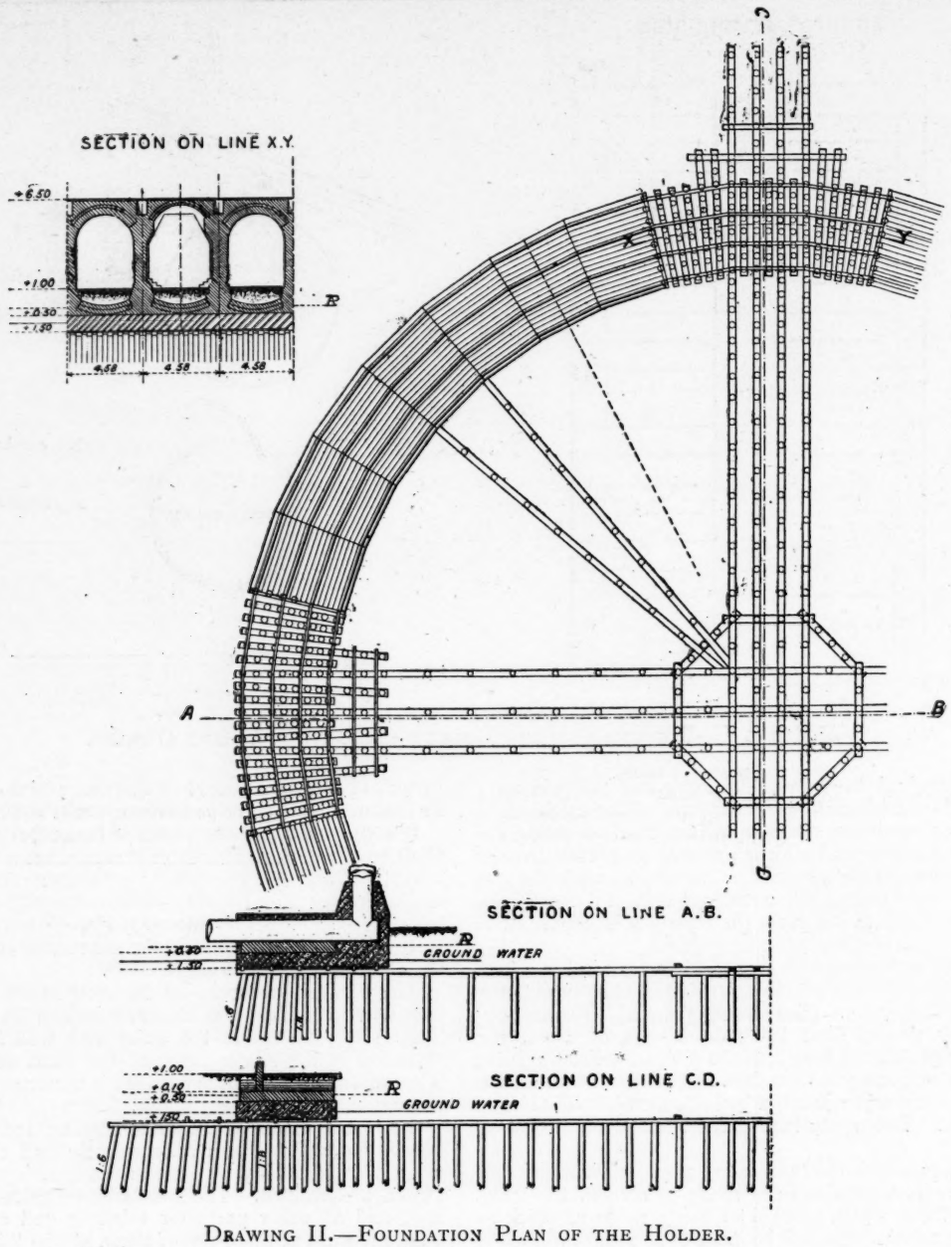
It is proposed that the plates of the outer circle of the tank shall be of Siemens-Martin mild steel, with a high allowable unit stress, and 26, 23·3, 19·4, 15·5, 13·8, 11·3, and 18mm. thick respectively. The riveting of the vertical joints is double; the horizontal ones being single-lap joints. The bottom plates are 16 mm. thick; and the joint with the exterior tank-shell is made with two angle-irons.

The whole construction of the inner mantle of the tank, as well as of the complete holder, is shown on the drawings. The gallery on top of the outer tank wall is made solid; transferring the whole force of the wind on to the wall. The solidity of this gallery makes it unnecessary to use any diagonal braces, as it is calculated as a rigid beam.

The construction of the guide-framing is after the German patent No. 78,457, with a completely stiff or rigid framework, as may easily be seen in the drawings. Compound strains are avoided. The standards are calculated for bending; and all other parts for bending and crushing. The wind pressure at this point is taken at 250 kilos. per square metre. The rollers are on the tangential system, each of the twenty standards having two for each lift.

To return to the tank; this being the chief feature of the structure. Guide-framing is built for much larger holders; but a tank of this size, considering the special conditions of soil, is a novelty. The roof of the central space is made of sheet iron, resting on forty radial horizontal beams, supported by forty vertical stays; these last serving also to support the curved plates and transmitting water pressure to the annular space. To support the vertical stays, struts run from the horizontal beams, and give, by their shearing force, an exterior bending stress. The horizontal beams meet in a central ring or star; and the forty rays of the star are joined with hinges to the beams, rendering the whole construction liable to static calculations, necessary here, as lateral compressions are to be expected on account of the nature of the subsoil. Without static stability, any construction would be dangerous.

The bottom plates of the ring rest on the brick wall, and are joined to the exterior tank wall. The whole system will be in equilibrium if the water pressure on all sides is equal. Settlement in the ground on one side, however, alters the stresses due to the weight of the water on the central space, as well as on the curved plates and vertical stays; thus increasing the slope. Therefore, a ring, rigid in a level sense, is laid on the exterior ring of the horizontal beams and joined with diagonal tiers between the stays to the annular bottom. The ring and tiers do not bear any weight so long as the tank is straight.



Drawing II.—Foundation Plan of the Holder.

The ring, as well as all other parts of homogeneous iron, is so constructed that a maximum of 1200 kilos. per square centimetre, or 17,000 lbs. per square inch, is allowed for, but never reached—it being generally considerably lower; and the diagonal tiers in their half length really afford four-fold security against any bending and crushing, when the whole structure sinks 8 inches on one side. To prevent this sinking becoming more than 8 inches, the eighty lifting appliances as put together under the stays will come into action after the tank has been emptied.

The principal parts of the tank construction are shown on Drawing No. IV.; *a* being the horizontal beams between the hinge-joints; *b* the central star; *c* the vertical stays, with the curved sheets *k*; *f* the roof sheets, with the ring *g*; *d* the diagonal tiers; and *e* the struts. The principal dimensions, given in centimetres, are: Exterior diameter of tank, 6130; height, 989; width of the ring, as far as the front of the stay, 215; diameter as far as exterior of stays, 5700; height to the roof sheets, 918; total length of roof beams, 5500; height of stays to the beams, 863; and the diameter of the theoretic side of the curved sheets to the front of stays, 12. It is not intended to give all the calculations for the tank. They are made by the well-known Privy Council Professor Barkhausen, of the Polytechnic School of Hanover. Still it is necessary to give the introduction, in order to show how the loads are distributed on the different parts of the structure.

To obtain a high shearing force in the struts *e*, the roof is charged with 16 inches of water. In order that the roof and the tank ring can be filled separately, a weak annular sheet *l*, 39 cm. high, is constructed. The gas pressure being 20 cm., the weight on the roof will be 60 cm., or about 24 inches, further augmented by its own weight.

The following cases have now to be considered:—

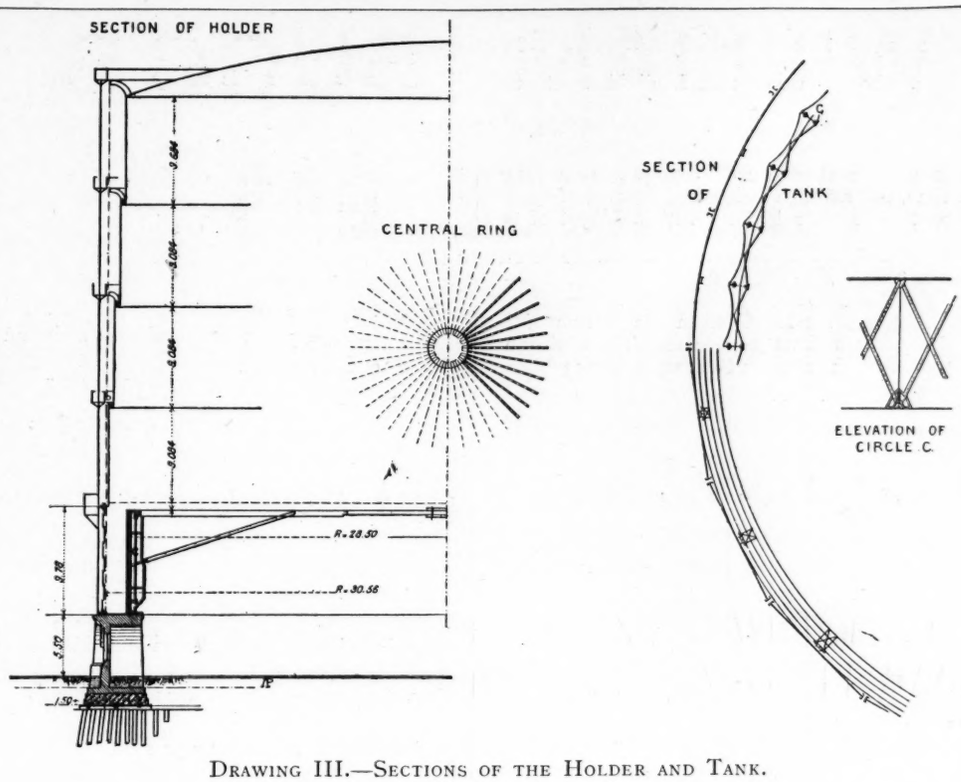
(1) In addition to the weight of material from which the holder and tank are constructed, a uniform load of 60 cm. of water.

(2) The tank sinks 20 cm. over one side, the whole gas-pressure working. In this case, a uniform load of 50 cm. of water and a wedgewise load—at one side zero, at the opposite of 20 cm. of water—has to be considered.

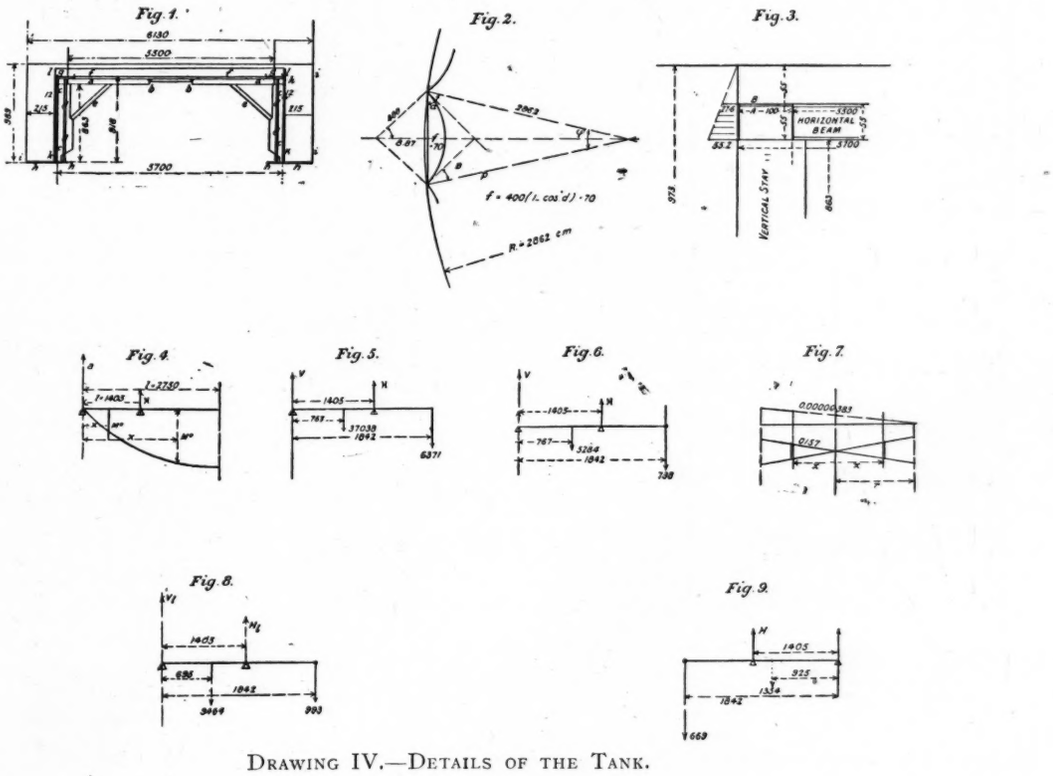
(3) The tank is filled, but without gas in the holder; and there is a uniform load of 40 cm. of water on the cover or roof of the tank. This case has to be calculated separately, as the struts *e* undergo the full pressure from outside, but a much weaker bending shearing pressure from inside.

(4) During the simultaneous filling of the roof and the annular space, the degree of filling must be found, where the shearing force on the strut, diminished with the outer pressure, is a maximum. In other words, the case of maximum outward bending of the struts.

Diagram I. of the grapho-statics shows clearly the moments resulting from the load of 973 cm. of water on two



DRAWING III.—SECTIONS OF THE HOLDER AND TANK.



DRAWING IV.—DETAILS OF THE TANK.

intermediate curved sheets.* The load is to be found by the calculation of the buckled sheets.

The radius of the circumference of the theoretic curved sheet is $\frac{5700}{2} + 12 = 2862$ cm.; thus $ab = 2 \times 2862 \sin 4^\circ 30' = 450$ cm., in Drawing No. IV., fig. 2. The radius of curvature is fixed at 400 cm. Under the highest load possible, of 988 cm. water, the stress on the curved sheets is $0{\cdot}988 \times 400 = 395$ kilos. for a height of 1 centimetre, or by a thickness of 0·5 cm., the strain in the unweakened sheet is 790 kilos. per square centimetre. The sheets are riveted with 12 mm. rivets, double in the lower half, single in the upper at a distance of 5·7 cm.; the strain in the riveting line being $\delta = \frac{5{\cdot}7 \times 395}{0{\cdot}5\,(5{\cdot}7 - 1{\cdot}2)} = 1001$ kilos.

In fig. 2 $\sin \alpha = \frac{450}{2 \times 400}$, or $\alpha = 34^\circ\ 13'\ 44''$ and $\beta = 51^\circ\ 16'\ 16''$. Therefore the force on the stay at a depth of 988 cm. $p = 2 \times 395 \times \cos 51^\circ\ 16'\ 16'' = 494{\cdot}25$ kilos., or 489 kilos. under a load of 973 cm., as will be first examined; the force at the upper end being $\frac{494{\cdot}25}{988}\ 110 = 55{\cdot}2$ kilos.

* The scales given on Diagrams I. to IV. are those on the original diagrams. The reproductions are on smaller scales.

The total pressure against the vertical stay is $\frac{489 + 55{\cdot}2}{2} 863$ = 234,822 kilos. (shown in Diagram I., divided into ten separate proportional forces. (For the diagram is taken 234,330 kilos.*) With these loads a polygon of forces is drawn for 20 cm. pole distance on the scale of 1 to 100, giving the moments on a scale of 1 cm. = 4,000,000 cm. kilos. At the same time, the average horizontal shearing force of the strut at 90,000 kilos. is calculated with a height of the triangle of pressure of $\frac{90{,}000 \times 863}{4 \times 4{,}000{,}000}$ = 4·84 cm. The difference shows that the maximum of the remaining moments lies about one-fourth of the length from the bottom of the stay and seven-twentieths from the top end. The horizontal force transmitted from the stay on the roof is 86,033 kilos.; and that on the bottom 148,297 kilos. The pressure given

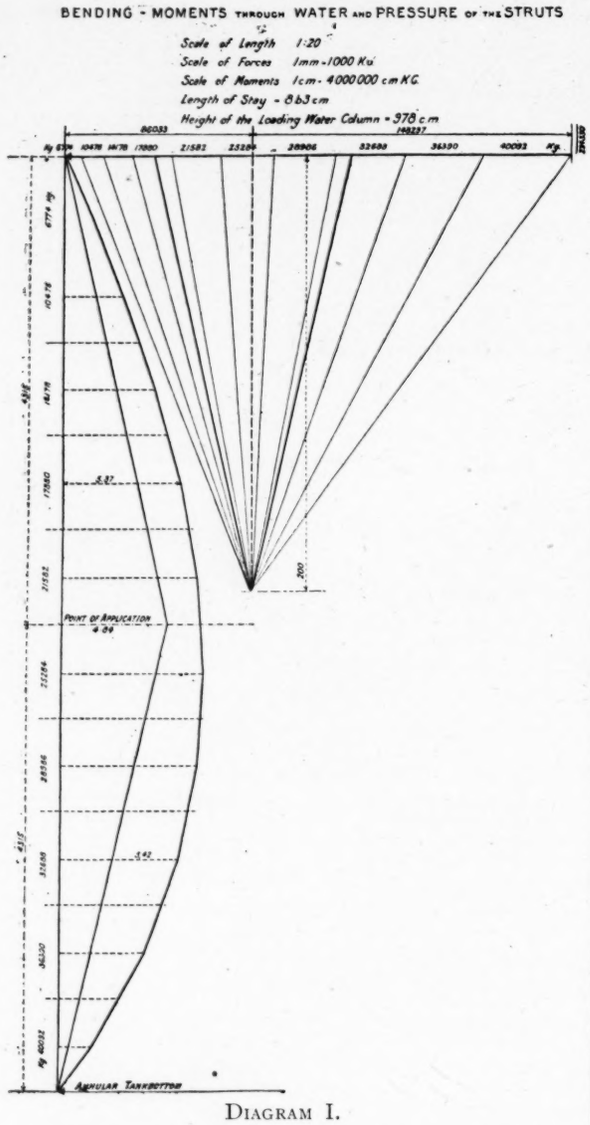

BENDING - MOMENTS THROUGH WATER AND PRESSURE OF THE STRUTS
Scale of Length 1:20
Scale of Forces 1mm=1000 Kg
Scale of Moments 1cm=4000000 cm KG
Length of Stay = 863 cm
Height of the Loading Water Column = 378 cm
86033
148297
POINT OF APPLICATION
ANNULAR TANKBOTTOM

DIAGRAM I.

by the buckled sheets on the end of the beams above the stays is in A = $\frac{55 \times 5 \times 27{\cdot}6}{6}$ = 1265 kilos.; in B = $\frac{55 \times 4 \times 27{\cdot}6}{6}$ = 1015 kilos. (fig. 3).

Diagram II. of the grapho-statics shows the moments of half of the beam caused by its own weight, and a load of 40 + 20 cm. pressure of water and gas. Notwithstanding that a strong sheet *g* (fig. 1) is put on the extremity of the beam, the thickness of the sheets will have to be examined for that part. Thus for $\frac{5500}{2} 2 \times \sin. 4° 30' = 432$ cm. The load of water in p = 0·01 × 0·01 × 0·6 × 1000 + 1 × 1 × 0·6 × 0·0078 = 0·0647 kilos. per sq. cm. The bending x of the sheets under this load p for a length l, a thickness δ, and a modulus of elasticity of Σ, is calculated from the formula—

$$x \left\{ \left(\frac{x}{l^2 + 4x^2} \right)^2 + \frac{3}{10} \frac{\delta^2}{l^4} \right\} = \frac{3p}{64 \times \Sigma \times \delta}, \text{ giving } X = 4{\cdot}31 \text{ cm.}$$

The load on the sheets corresponding to this bending is $p_2 = \frac{32}{5} \frac{\Sigma \delta^3 x}{l^4}$ = 0·00036 kilo. per sq. cm., and the load on the curved sheet, regarded as a catenary is $p_1 = p - p_2$ = 0·06437 kilo. per sq. cm. The tensile strain on the catenary is $H = \frac{p_1 l^2}{8x}$ = 350 kilos.; and the maximum strain in the sheet $\delta = \frac{l^2}{8\delta} \left(\frac{p_1}{x} + \frac{6 p_2}{\delta} \right)$ = 725 kilos. It shows that the riveting of 12 mm. is sufficient without weakening the sheet too much.

The load on the outer end of the beam for a length of 1 cm., due to the dead-weight of the sheets, is 432 × 0·6 × 1 × 1·2 × 0·0078 = 2·42 kilos., due to the water 4·32 × 0·6 × 0·01 × 1000 = 25·9 kilos., or total 28·32 kilogrammes. Coming nearer to the centre, this load becomes gradually less by a quantity of $\frac{28{\cdot}32}{2750}$ = 0·0103 kilo.

Half the length of the beams is divided into twenty equal strips 137·5 cm. long; the load on the first strip being $\frac{28{\cdot}32 + 28{\cdot}32 - 137{\cdot}5 \times 0{\cdot}0103}{2}$ 137·5. Adding to this the dead-weight of 1·64 kilos. per 1 cm. beam, we find a calculated total weight of 4012 kilos. All the other loads are calculated the same way. The total load of all strips is—

Of iron sheets . . $27{\cdot}5^2 \pi \frac{1}{2} 1{\cdot}2 \times 0{\cdot}0006 \times 7800 \times \frac{1}{20}$
Of water . . . . $27{\cdot}5^2 \pi \frac{1}{2} 0{\cdot}6 \times 1000 \times \frac{1}{20}$
Of dead-weight. . 1·64 × 2750—total 43,409 kilos.

Addition is also to be found in Diagram II.

With a pole-distance of 20 cm., a polygon is drawn, representing by its ordinates the moments in a scale of 1 cm. = 4,000,000 cm. kilos., and called M_o.

The point *a* is found by testing, where a support is to be brought, in order that, under the supposition of no change whatever in height, the moment M_o, less the moment of the supporting force about the end of the beam with 0·98 cm., remains a little larger than the negative one about the support with 0·91 cm. This inequality is introduced on account of the length pressure getting larger through the shearing force on the support than on the end. The point *a* is chosen 1405 cm. from the end of the beam, and the supporting force in fig. 4

$$X = \frac{3 \left\{ \int_o^b M_o \, x dx + b \int_b^l M_o \, dx_1 \right\}}{b^2 (3l - 2b)}$$

Taking in Diagram II. all measures in mm., we find for $\int_o^b M_o \, x dx$ = 13·75 (8 × 9·1 + 21 × 21.2 + 33 × 34·8 + 44 × 48·2 + 13·75 { 54·2 × 4·5 + 63 × 5·5 + 70·7 × 6·5 + 77·5 × 7·5 + 83·2 × 8·5 + 88·4 × 9.5 }) + 3 × 91 × 139 = 690,400; the centre of gravitation having been calculated only for the four outer strips.

$b \int_b^l M_o \, dx_1$ = 140·5 { 134·5 × 91·4 + 2/3 134·5 (105 − 91·4) } = 1,898,000, giving x = 28,800 kilos., with a negative moment of 1405 × 28,800 = 40,500,000 cm. kilos., drawn in Diagram II., with 10·12 cm. The intersection of a horizontal line through *a*, with the line of the moments fixes the situation of the hinge at a distance of 437 cm. from the support. Outside the hinge acts the total load of 37,038 kilos. 767 cm. from the end, and 6371 kilos. about the hinge. The supporting force about x is in fig. 5—

$$X = \frac{37{,}038 \times 767 + 6371 \times 1842}{1405} = 28{,}572;$$ and on the end $\checkmark$ = 43,409 − 28,572 = 14,837 kilos.

In Diagrams III. and IV., in combination with figs. 6, 7, 8, and 9 of the static calculations (which, I believe, it will not be necessary to reproduce), are shown the diagrams of moments under a load of water of 10·2 cm. on the roof, and under a wedgewise load of water of 21·1 cm. at one side, and zero

* This and also some other slight differences in the ciphers to be found by direct calculations and those used here, are due to the use of a slide-rule.

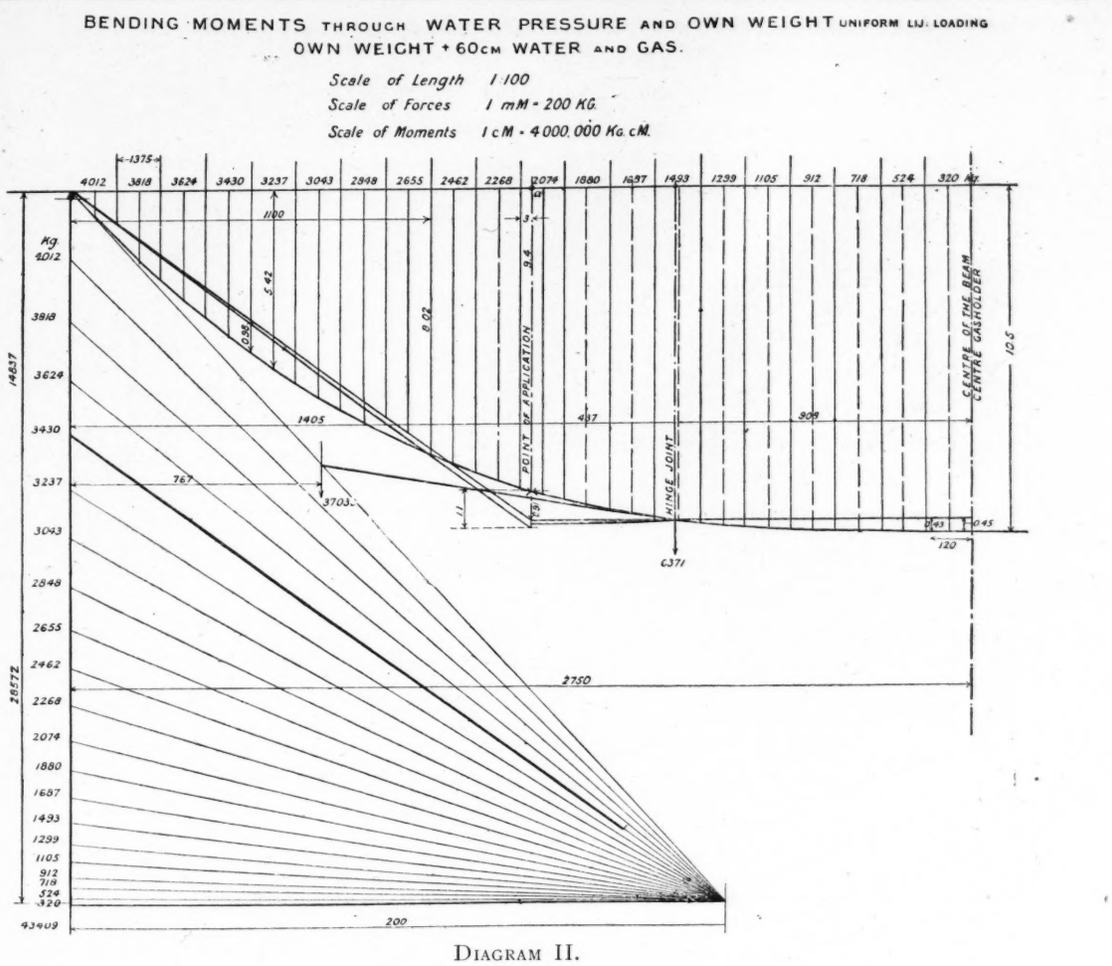


DIAGRAM II.

at the other. The ciphers 21·1 and 10·2 are chosen, instead of 20 and 10 cm., on account of previous calculations, but in advantage of the construction.

By means of these fundamental diagrams, all other calculations can be made, and the whole structure of the tank examined in detail. This would lead us much too far, and would be asking too much of the time and patience of this audience, however interesting the point—especially those of the central star, the joint of the vertical stay with the bottom plates of the tank, and the exterior ring *g* (fig. 1).

Of very great interest is the simultaneous filling of the cover of the central space and the annular tank. Both must be filled at the same time; the tank having a capacity of 4545 cubic metres, and the cover of 974 cubic metres, the filling must be in the relation of 1 to 4·67. The cover having two concentric spaces, the filling of both parts has also to take place in proportion to the surfaces, thus as 1 : 8·4. Special boxes with overflows, dividing the water in the required quantities, are therefore made on purpose. The same care has to be taken in the case of emptying the tank.

Very important also is the construction of the hinge-joint in the horizontal beams. The calculations show that they have to bear a vertical load of 6640 kilos.; and there is also a maximum horizontal force of 136,281 kilos. Hence the maximum load on the bolt is 136,500 kilos. Admitting a bending strain of $s^b = 1200$ kilos., and a shearing strain of $s^d = 2000$ kilos. per square centimetre, the diameter of the bolt is given by the formula—

$$d = \frac{1{\cdot}265\ \sqrt{D}}{\sqrt[4]{s^b\ s^d}} = 11{\cdot}9 \text{ cm.},$$

and the thickness of the links—

$$\delta = 0{\cdot}397 \sqrt[4]{\frac{s^b}{(s^d)^3}} = 2{\cdot}88 \text{ cm.}$$

Discussion.

Mr. FOULIS said they had heard a very interesting paper, and he was sure they were all very much obliged to the author (M. du Chattel) for bringing the matter so fully before them. There was just one point, perhaps, which he might clear up before any discussion was commenced. Would the author tell them—what did not seem to be very clear from the paper—the necessity for such a peculiar construction of tank? Was it the space that was wanted?

M. DU CHATTEL explained that, owing to the congested state of the works, and the necessity for putting the new holder in this particular spot, they had to build the tank in this form, in order that the railway for the delivery of the coal might be carried through it.

Mr. CHARLES HUNT (Birmingham) asked if he understood the author correctly, in supposing that the method of construction was followed in order to get a railway into the works. Of course, the circumstances must govern the case—the method of construction followed. He should like to ask the author about the framing. M. du Chattel had referred to the German patent No. 78,457; but they were not all familiar with it, and there was not any description of the framing in the paper. Were they to understand that these were simply vertical steel joists braced? And what was the object of the hand-railing for each lift? He noticed, also, that the author did not propose to follow the more modern English method of running one or two lifts out of the framing. He must express his indebtedness to the author for having given them so excellent a paper upon a method of construction which was not altogether familiar.

Mr. C. C. CARPENTER (London) did not know that he had many ideas on the subject. He thought it would be unwise to look at the paper from the ordinary point of view. It was well known that in our days the progress which was made in all industries had had an earlier foundation laid in some abstruse paper which had been put away in a pigeon-hole, perhaps many years ago. He thought they ought to look upon this paper in such a light, and as a study of the possibilities of gasholder construction in an entirely different way from their own. They might not have opportunities for this method of construction themselves. They might not be similarly situated; but they had now in the records of the Congress a description of ready means of getting over difficulties of the kind.

Mr. W. W. WOOD (of Messrs. R. D. Wood and Co., of Philadelphia) said he had been very much interested in seeing what was to him an entirely novel way of building

BENDING-MOMENTS WITH A UNIFORM LOAD OF 20 cM OF WATER

Scale of Length 1:100

Scale of Forces 1 mM = 200 kG

Scale of Moments 1 cM = 600 000 kG cM.

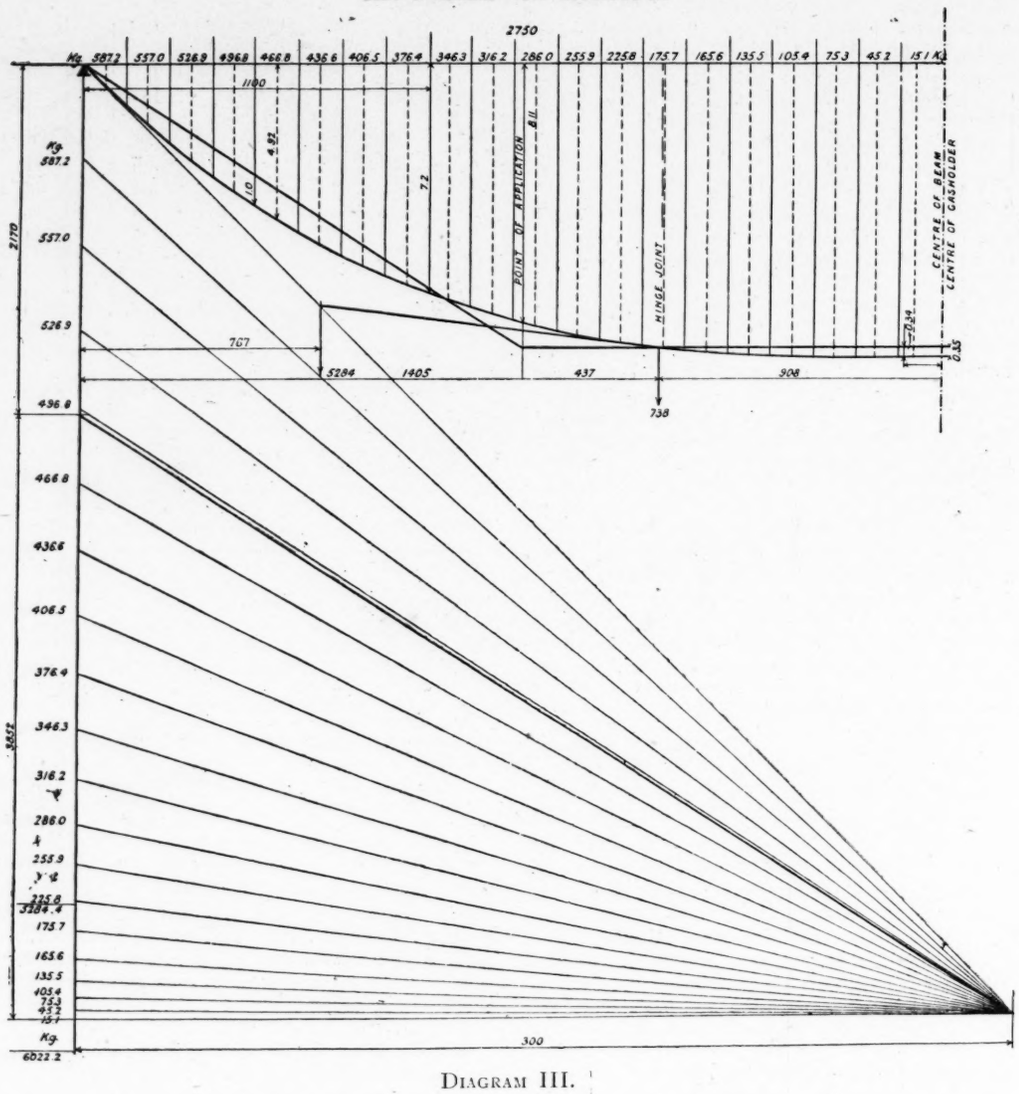


DIAGRAM III.

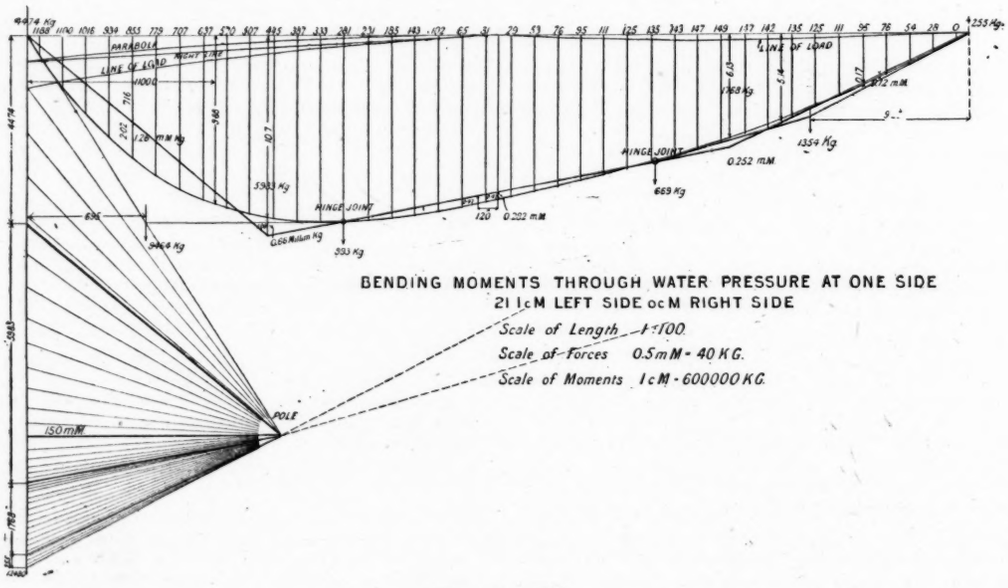


DIAGRAM IV.

gasholder tanks. The question largely depended, it struck him, as the author put it, on the possibility of sustaining a column of water which was equal to the depth of the tank. If the ground were not sufficient for maintaining per square foot the brickwork and the quantity of water which the tank would hold, it would be a very difficult problem to solve. It occurred to him, however, if he had taken the whole weight of the water and the whole of the annular range, whether it was not taking a severe test of the stability of the ground he was putting the weight on. He did not know exactly how many feet there were in the annular ring; but it seemed to him that ground that was sufficient to stand that weight would be sufficient to sustain a holder of a different order of construction. He was sorry they had not any holders of the kind in America. Their plan was generally simply to have a flat-bottomed steel tank, resting upon a concrete foundation, supported by piles or by the ground, carried down to a firm soil. Masonry tanks had largely given place to steel tanks. Of course, there might be circumstances where a masonry tank could be put down more economically than a steel tank; but they found no difficulty from the freezing of steel tanks, and they were practically being universally adopted.

The CHAIRMAN said if there were no more remarks, he might ask M. du Chattel to reply. He was sure they were all very much obliged to him for bringing the paper before them. It was a paper they might differ in their views of—as to the practicability of carrying out such a structure. They were very much indebted to him for bringing it before them, and for having so carefully considered and given them all the strains and calculations as to the different parts of the structure. There might, of course, be conditions in works where it was necessary to put down a gasholder in a position in which it would not interfere with the railway traffic through the works; and he understood that the object of this proposal was to utilize the ground without interfering with the facilities for carrying on the manufacture. Perhaps M. du Chattel would tell them if that were so.

M. DU CHATTEL said he would be happy to answer some of the questions which had been put. In the first place, it was not only the railway, but there was another advantage in making a tank like that, and not a steel one filled with water. The ground was very dear; and they had under the tank a big store-room in which they could place anything they wanted. It was a place of nearly 3000 square metres. As to the framing to which he referred, it was the German patent of Herr Klönne. It was merely a question of rollers; and he could not say much about it. Of course, the framing went the height of the whole four lifts. He should think that if the paper were made a study of, it would be better to pursue the discussion of it in the "JOURNAL OF GAS LIGHTING." He would give any information, and answer any question they might ask him there. He knew it was a little too mathematical, perhaps, and too theoretical; but he always said that it was of advantage to be complete in theory. He thanked them for the kind way they had taken his paper; and he repeated that he was willing to give any further information in the "JOURNAL."

Directors' Magnanimity and Employees' Loyalty.—There has been some disturbance of the peace between the Bristol Tramways Company and a section of their employees; but in the face of a considerable exhibition of hostility, many of the men stood loyal to their employers. The Directors have signalized their appreciation of this fealty in a large-hearted way. In addition to the extra pay to the workers during the trouble, the Directors have determined to institute a decoration in the way of a specially designed silver medal, upon which each recipient's name will be engraved. The possession of this medal will entitle the recipient to a special gratuity for all time, as long as he remains in the Company's service, at the rate of 2s. a week for foremen and inspectors, 1s. for drivers, and 6d. for conductors, to be increased from time to time as any holder in one class gets promoted into a higher one. Beyond this, however, the Directors feel that there is a personal bond of sympathy between them and the loyal employees which they would like to recognize; and they have come to the conclusion that the most practical form in which they can do this is by setting apart the whole amount which they personally receive from the Company for their services as Directors during the present year, which will amount, in the total, to £2200. They intend that this shall be a free gift to distribute among all those employees of the traffic department who were in the service of the Company at the outbreak of the disaffection, and who had consistently stuck to the Company. Recognition by Directors of faithful service, by dispossessing themselves of fees, is a unique proceeding which ought to receive a very wide publicity; and we have pleasure in helping thereto.

ESSAYS AND REVIEWS.

THE LABOUR MARKET IN 1900.

THE annual report of the Labour Department of the Board of Trade on the changes in rates of wages and hours of labour which took place in 1900 was issued recently, and contains a large quantity of matter most interesting to employers and to all concerned in labour questions generally. The year 1900 was, it is pointed out—and as we have before noted—the culminating point of the upward movement of wages which began in 1896. Not only did the general level of wages in the United Kingdom stand higher at the end of 1900 than in any other year for which statistics exist, but the rate of increase during that year was unprecedentedly high. If we confine ourselves to the industries for which it is possible to obtain definite statistics, we find that no fewer than 1,112,684 workpeople, or about one-seventh of the total number employed, received advances during the year amounting to no less than £212,000 a week; while only 23,010 workers sustained decreases to the unimportant amount of £2800 a week. The net weekly rise of £209,000 compares with £91,000 in 1899, and with £81,000 in 1898.

Taking into account the various dates at which the changes came into operation, it is estimated that the additional amount disbursed in wages during 1900 (occasioned solely by increases of wages recorded by the Labour Department, and apart from any change in the number of workers or any improvement in the number of days of full employment) was not less than £6,000,000. At the end of 1900, the rates of wages current exceeded those in force at the end of 1897 by an amount equal to an increase in the earnings of those participating in the benefits of the higher scales of pay at the rate of about £20,000,000 per annum.

As in the two preceding years, by far the larger amount of the increase in 1900 is accounted for by the rise of coal miners' wages, which were advanced, on the average, about 4s. 10d. per week in the course of the year—the rates of pay being £164,500 per week greater at the end than at the beginning of 1900, or 80 per cent. of the total recorded weekly increase of wages. This large increase was distributed over some 680,000 men, equal to 82 per cent. of the whole number of workpeople engaged in or about coal mines. The average advance was highest in Scotland (8s. 6d. per week), followed by South Wales and Monmouth (7s. 5d. per week). In the federated districts, the advance was only 2s. per week; but further increases—equal together to another 2s. per week—were arranged to come into force in January and February of this year. The Northern Counties received about 6s. 5d. per week advance. Of the 705,000 men employed in mines and quarries who received increases in wages last year, all but 1447 obtained the higher rates of pay without recourse to a strike. The majority were granted increases by virtue of the operation of sliding-scales (125,000), conciliation boards (461,000), and mutual arrangement or otherwise (117,000). In the course of the past three years, the wages of practically the whole of the coal miners in the kingdom have been raised to the extent of 8s. 1d. per head per week.

Next to coal miners, but a long way after, come workers in the metal, engineering, and shipbuilding trades. Of these, 95,285, or only 8 per cent., obtained increases equal to 3s. 5d. a head per week. The briskness of demand for labour in these industries, which was a feature of the four years preceding 1900, continued through the first half of that year. In the second half, there was a slight falling-off in the amount of employment offered, but not sufficient to affect materially the mean percentage for the whole year. In 1893 and 1894 the number of unemployed in these trades exceeded 11 per cent., in 1895 it exceeded 8 per cent., in 1896, 97, and 98 it was between 4 and 5 per cent., but in 1899 the percentage was only 2·4, and in 1900 2·6. As was the case in 1899, the trades engaged in the production of iron and steel shared much more largely in the advance of wages than the others included in this group. In the metal, engineering, and shipbuilding trades, no serious dispute as to wages arose—less than 2000 out of 95,000 men going successfully on strike in order to obtain increased wages. A large proportion of the advances granted were due to sliding-scales, and some to Conciliation Boards.

So far as the building trades are concerned, it may be remarked that the steady rise in wages which has been observed for some years, continued last year in England and Wales, but was checked in Scotland. During the past seven years, the only decrease in the wages of builders' labourers in England, Wales, and Ireland reported to the Board of Trade affected four workpeople. In the same period, increases were granted, on an average, to over 50,000 hands per annum. In Scotland, increases were given to over 10,000 hands per annum until this year, when only 700 hands received an advance, while 8700 suffered a decrease. Assuming that no man received more than one advance during the period, about 70 per cent. of all the labourers employed in the building trades have, since 1893, had their wages increased by nearly 2s. per week. This is a fact that has a material bearing upon the housing question, and should not be forgotten by those who wish to pose as the friends alike of the working classes who want moderate-rented houses, and of the bricklayers and plasterers who, with no hesitation, go on strike for more pay for less work, and who of set purpose do as little work as possible when not

on strike. It is to be noted that a far higher percentage of the men granted increased wages, obtained them after a strike in the building trades group than in any other. Of the total number of workpeople whose wages were changed last year, less than 5 per cent. went on strike; in the building trades, over 20 per cent.

Passing by the textile and clothing trades—in which wages showed an upward tendency in 1900—we come to the group of miscellaneous trades, in which are included gas workers other than those employed by public authorities. Of these, 3620 are known to have received in 1900 increases of wages averaging 1s. 5d. per week. This total (which is much higher than that in any of the past eight years, except 1898, when a total of 7485 men received advances equal to 2s. 5d. per week) includes 1050 men employed by the Newcastle-on-Tyne Gas Company, 719 employed at Bristol, 553 at Sheffield, 409 at Sunderland, 277 at Jarrow-on-Tyne, 269 at Wolverhampton, 184 at North Shields, and others. No decreases are recorded. Among the employees of local authorities, we find increases were granted to 2735 gas workers—including 603 at Salford, 471 at Bradford, 380 at Birmingham, 280 at Leeds, 216 at Belfast, 185 at Walsall, and others. One decrease is recorded, affecting 9 engine and boiler men at Blackburn who had their wages reduced by 7s. 6d. a week on the adoption of the eight hours' day. The grand totals are 6355 gas workers granted higher wages, against only 9 whose wages were reduced.

The upward tendency in the wages of workpeople in public employment continues. Excluding the police—a considerable number of whom received higher rates of pay last year—9400 public employees, other than Government servants, obtained increased wages last year, compared with a total of about 40,000 in the preceding five years. These figures are little likely to show a falling off in the future, though there are faint indications on which to found a hope that our local governors are beginning to realize that a limit must be placed in this direction. We are not, however, prepared to go so far as a writer in the last issue of the "Economic Review," who remarks—in reference to a recent debate at Spring Gardens on a proposal to fix a minimum wage of 30s. per week for all classes of labour employed by the London County Council—that it is "clearly felt on the Council, apart from the labour bench and a few extremer partisans, that it, and perhaps most other municipal authorities in London, have gone far enough in the direction of model employment, although it may be noted that in the early nineties it was mainly owing to social [and political] rather than to economic considerations that the rate of pay to unskilled municipal service was then so largely increased." We only wish that we could think that this is "clearly felt" on the London County Council. Time will show if it be the case. The rest of the paragraph from which we have quoted may well be given here. The writer (Mr. E. Aves) proceeds:

> It was, for instance, between 1891 and 1895 that in one London district the number of road sweepers earning more than 25s. a week rose from 4 per cent. to 51 per cent. of the total number employed. It is more widely recognized now, however, than then that when changes of this kind are made, it is often the unexpected [*i.e.*, unexpected, but not unforeseeable] that happens, and that when higher rates of pay are secured to bodies of workers such as road sweepers, dock labourers, and gas workers, another set of men tends to secure the benefits; the older generation of underpaid worker finding his position undermined by the keener competition of more efficient men that the new order of things introduces. For the less efficient man, "progress" and "improved conditions," whatever they may be to others and to society at large, are often but a cruel kindness—others reaping the fruits of the pity that was stirred, it may be, by his own miserable lot.

That is to say, briefly, that the operation of economic laws cannot be suspended at will by the sentimental meddler in business concerns—a lesson that a large number of our "municipalizing" friends have yet to learn.

As to changes in hours of labour, the number of workpeople affected thereby, and the aggregate reduction in working hours, were both considerably greater in 1900 than in 1899. This is accounted for by the adoption of the eight hours' day by 26,500 coal miners in Lanarkshire—we say adoption by those miners, because they merely announced their intention of not working more than eight hours per day in future, and the masters submitted rather than precipitate a strike in the height of the coal boom. The total number of hands whose hours of labour were reduced last year was 57,726; and the average reduction was just over four hours per week. That the movement in favour of shorter hours of labour has not made great progress in recent years is shown by the fact that the total effect of all changes during the past eight years, if spread over the whole working population, would amount to less than 10 minutes per head per week. Besides the Lanarkshire miners, only 1208 workpeople obtained the eight hours' day in 1900. This number included 60 gas stokers at West Hartlepool, whose wages were at the same time increased to 5s. 6d. per shift, with time-and-a-half for Sunday work. A further 163 gas workers, employed by public authorities, obtained a reduction in their hours of labour.

The year under review, as has been said, witnessed the passing of high-water mark in regard to wages. Toward the end of 1900, the Board of Trade report remarks, signs were not wanting that the period of rising wages was drawing to a close. During the first half of the present year, the increases of wages, though still more widespread than the decreases, have not balanced them in amount. So that, for the first time since 1895, the net effect has been a fall amounting to nearly £30,000 per week; the decline being, of course, most marked in the mining and iron and steel trades. It is to be feared that with the passing of the period of rising wages, will also pass the period of comparative peace enjoyed during the last two or three years in the industrial world.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 732.)

Business on the Stock Exchange was very limited, being to a great extent oppressed by the tragedy in the Western Hemisphere, which terminated fatally on Saturday. On that day, as a mark of respect, business was suspended; and, in this connection, a curious and unprecedented incident may be briefly noted. Owing to the absence of a competent authority to close the Exchange officially, the members present passed a resolution to dissolve, and accordingly dispersed. The general tone of the markets not dominated by the influence of movements in Americans was favourable, and the few variations in price which took place were for the most part upward; but the total volume of transactions was small. The fortnightly settlement revealed no difficulties. The Money Market was very easy, there being an abundant supply to meet the needs of the Stock Exchange and all possible requirements; and discount rates perceptibly relaxed. In the Gas Market, business was remarkable for being almost entirely restricted to one line—viz., Gaslight and Coke ordinary, with an occasional bargain in the secured issues. Apart from the operations in this undertaking, there was not enough done in all the rest put together to furnish what might be regarded as a moderate day's work. But quotations by no means suffered from the stagnation; for the ruling tone was strong to a marked degree. Several issues had a more or less substantial advance, and not one moved in the other direction. The inevitable recovery from the depression in prices wrought by the high cost of coal seems to be in fair swing. Gaslight ordinary continued to advance in value; and from 93 on the opening day, it pushed its way up to a closing mark of 96½. The secured issues were not remarkable. South Metropolitan was hardly touched, and Commercial not at all. The Suburban and Provincial group displayed a strong tendency; and Brentford, Brighton, Crystal Palace, Tottenham, and West Ham had a nice advance each. In the Continental group, Union monopolized attention, and scored a rise of four points. None of the rest presented any noticeable feature. The Water Companies were very buoyant; and every one made an addition to the recent advances they have been making in their quotation.

The daily operations were: Very quiet business marked the opening day. Crystal Palace and Tottenham "A" rose 2, ditto "B" 3, and both West Hams ½. In Water, Chelsea preference rose 1. Tuesday was almost a blank day, and Union advanced 2. In Water, Chelsea rose 2, and West Middlesex and Lambeth and Southwark debenture 1. On Wednesday, Gaslight ordinary was active, and moved up 1. Union gained 2. In Water, East London debenture rose 1. Thursday fell quiet again; but Gaslight ordinary rose 1, Brentford old 2, and ditto new 3. In Water, Lambeth rose 3, West Middlesex 2, and Chelsea, Lambeth, and Southwark debenture 1. Friday was the busiest day in Gas; but quotations did not move. In Water, Kent old rose 2½, ditto new 2, Chelsea, New River, and West Middlesex 2, and East London and Grand Junction 1.

Railway Station Lighting by Incandescent Gas-Lamps.—Since the publication of the article on "Old Lamps and New for Railway Station Lighting," the Engineer of the London, Brighton, and South Coast Railway (Mr. Chas. L. Morgan) has kindly sent us information which supplements the very satisfactory results obtained by other Railway Companies in the matter of lighting their stations by incandescent gas-burners. He says that the Company have four stations lighted by the Welsbach system—viz., Streatham Hill, Penge, Uckfield, and Heathfield; and, so far, the results have been very satisfactory. It is found in actual practice that the Kern burners give an increased volume of light to the ordinary No. 5 Bray's burners, with a less consumption of gas. The cost of maintenance amounts to from 4d. to 4½d. per lamp per month.

Coke for Treating Sewage.—Particulars have lately been furnished of some additional experiments carried out by the Commission of Experts at the pumping-station at Charlottenburg on the purification of town drainage. They related to: (1) The further examination of filtering materials; (2) the co-operation of air in the process of nitrification; (3) the effect on the action of the coke of allowing the foul water to previously undergo putrefaction. Baier found that gas coke, in pieces of 3 to 8 mm. in bulk, is less suitable as a filtering material than the metallurgical coke used in former experiments. The influence of an artificial supply of air on the revivification of the filtering material or on the degree of purification of the drainage could not be determined. Allowing the raw drainage to stand (putrefaction before treatment with coke) had no appreciable influence on the final degree of purification attained. Thiesing found that wood charcoal is not suitable as a filtering material for the purification of the Charlottenburg drainage; and Nietner found that coal slack is decidedly inferior to coke in this respect.

OBITUARY.

ALDERMAN LENNARD.

After a comparatively few hours' illness, Alderman SAMUEL LENNARD, the Mayor of Leicester, passed to his rest last Saturday afternoon; and the news plunged the community which he had served with faithfulness and ardour into a state of profound sorrow. The event has, indeed, removed from the municipal life of Leicester a worker of more than ordinary power. Respect and confidence of both councillors and burgesses were the rewards of his uprightness, transparency of conduct, and openness at all times in rendering an account of his policy and work in the positions to which he had been called. It was in connection with his labours on the Gas and Electricity Committee that we knew him best; and personal contact with him long since satisfied us as to the sincere interest and purpose which animated him as the Chairman of these departments. His friend Mr. Alfred Colson —the official head of the departments—will sadly miss him. Theirs has been no ordinary companionship in those great, progressive, and prosperous businesses, on the helm of which they both kept steady hand. One was the confidant of the other; and they were allies in working for the good of both undertakings.

It was in 1882 that Alderman Lennard entered the Council. At the end of four years, he became Vice-Chairman of the Gas Committee, and two years later took the principal chair. This he retained to the time of his death, continuing to hold it even when he assumed the Mayoralty. Once intimately connected with this great department, he applied himself diligently to master the multifarious details of the manufacture of gas, with a success which gratified his colleagues, though, knowing him, it did not surprise them. He had at his right hand a sound adviser in Mr. Colson. How the department grew, Alderman Lennard explained from time to time in presenting the report of his Committee. Advantages to consumers, which last year alone were equal to an aggregate reduction of £41,000 on charges, did not prevent large profits. His Worship pointed out last November that, since the first balance-sheet presented to the Council in 1878, after meeting all charges of every kind whatsoever, a profit had been made up to that time of £572,757, or an average of £26,034 per year; while with a capital account of £983,558, the present commercial selling value of the undertaking was at least two millions sterling. Alderman Lennard would never have thought of claiming all this as the result of his work. But he did his part in the attaining of these advantages; and at least the figures prove the magnitude of the business of which he took charge as a member of the local governing body. But this did not exhaust his energy. The development of electricity as a motive power and for purposes of illumination was urging private capitalists to embark upon works for the production and utilization of this energy. There were proposals for the establishment of a company, or companies, in Leicester. Alderman Lennard protested that electric lighting works, like the business of gas-making, should be in the hands of the Town Council. He urged that the invention was then in its infancy, and that it would be better for Leicester to await larger experience and fuller knowledge. Eventually, however, the electric lighting works were laid down at Aylestone Park; and a few years' working has justified the late Mayor's prognostication that in a short time the electric lighting works would more than pay for themselves, and throw no burden upon the rates. But still the department extends; and only a few months ago his Worship, with his usual business tact, acquired for it 120 acres of land at Thurmaston, for new works, at a price highly favourable to the community. This new scheme will have to be worked out; but Alderman Lennard, unhappily, will not be there to superintend it. Notwithstanding this success, the Gas Department goes on prospering and expanding.

Alderman Lennard was a native of Leicester. He was born on June 5, 1851; and from boyhood he had been closely associated with the town and its institutions. The deceased did not enjoy exactly robust health; and for several days previous to his death, he had been apparently suffering from slight attacks of heart weakness, and had consulted his doctor. It was not, however, until last Friday night that the more alarming symptoms appeared and that his condition gave rise to the gravest fears. The end came, as stated, on Saturday afternoon; and the melancholy news was communicated to Leicester by his father-in-law, Alderman Wood, the Chairman of the Water Committee.

We regret to record the sudden death, on Monday afternoon last week, of Mr. FRANK BARRETT, Manager and Secretary of the Ramsbottom Gas Company. Mr. Barrett, while seated at work in his office, was suddenly seized with illness, and died in a few minutes. He entered the service of the Company when a youth, and rose to the position of Secretary about three years ago. He was appointed, in addition, Manager at the gas-works, and under his supervision the Company have had much financial success. He was a member of the Gas Institute and of the Manchester District Institution, having joined both bodies in 1899. Deceased leaves a widow and two sons. His painfully sudden death, at the age of 48, has caused deep regret in Ramsbottom.

The Water Committee of the Coventry Corporation have instructed the Town Clerk to retain the services of Mr. James Mansergh, for the proceedings to be taken in respect of the purchase of the North Warwickshire Water Company's works.

NOTES.

Facilitating Respiration in Deleterious Atmospheres.

A recent number of the "Comptes Rendus" contained the description of an appliance devised by MM. Chauveau and Tissot to enable a man to work in an atmosphere contaminated by deleterious gases. Apparatus contrived with this object was, it may be remembered, brought under the notice of the members of the Société Technique du Gaz, at their last meeting, by M. Bachelay, and described and illustrated in the "JOURNAL" for the 13th ult. (p. 394). The present appliance consists of a short transverse tube, connected by india-rubber piping to glass tips, which are placed in the nostrils. The tube is fitted inside with light aluminium valves, loosely hinged. The entire apparatus is attached to a closely fitting leather cap. Air is drawn in at one end of the tube and expelled at the other, and the common passage to and from the nostrils is made as short and small as practicable. Experiments have shown that the inflow-tube may be as long as 20 yards, or even more, without producing any appreciable difficulty in breathing, and that it is possible, when wearing the apparatus, to remain and work for certainly more than an hour (possibly much longer) in irrespirable atmospheres, such as carbon dioxide or coal gas, without any danger. The same experiments have shown that there is no sensible absorption of these poisonous gases through the skin. The apparatus is easily constructed and carried, is extremely light, and readily applied.

Dr. Glazebrook on Wind Pressures.

Speaking of the aims of the National Physical Laboratory, now in course of construction at Bushey Park, Hampton Court, Dr. Glazebrook, the President, said that part of the work to be done would be the verification of instruments for the measurement of wind pressure. The Board of Trade rules require that a maximum pressure of 56 lbs. per square foot must be provided for, and prescribe how the calculations must be made. These recommendations do not rest upon any special experiments. Dr. Glazebrook referred to Sir B. Baker's well-known wind gauge observations at the Forth Bridge works, which proved that the pressure on large surfaces is less proportionately than that measured by small areas. The same result may be deduced from the Tower Bridge observations. Power is applied here to raise the great bascules; and the amount of the power required depends upon the direction and force of the wind. From observations on the power registers, some estimate of the average wind pressure may be formed; and this is found to be less than the pressure registered by small wind gauges. Nor is this result surprising, when the question is looked at as a hydro-dynamical problem. The lines of fluid near a small obstacle will differ from those near a large one, and the distribution of pressure over the large area will not be uniform. Little is known, actually, about the manner in which the wind acts upon framed structures, especially in the case of lattice girders. In all probability, as Sir J. Wolfe Barry has pointed out, most engineering structures are made far more heavy than there is any real necessity for, by reason of our ignorance of these points.

The Value of Blast-Furnace Gases.

The subject of the "Profitable Utilization of Power from Blast-Furnace Gases" was dealt with in a paper read by Mr. B. H. Thwaite at the recent meeting of the Iron and Steel Institute in Glasgow. The author explained that the results of his researches into the question of the waste of fuel in iron and steel works had culminated in his invention for utilizing the waste effluent gases of blast-furnaces in internal combustion engines, and that this has made the blast-furnace a source of power rivalling even that from waterfalls. One of the results following the use of blast-furnace gas for the direct production of power in internal combustion engines had been marked progress in the mechanical perfection of the power capacity and the thermodynamic efficiency of such engines. He said that as high an efficiency as 30 per cent. had been obtained, and one of 25 per cent. should always be obtainable, and the power capacities of these engines was now no more limited than were those of the steam-engine. Mr. Thwaite described his scheme in detail. It includes the recovery of the heat which is otherwise lost in cooling the gases, for heating the air to gasify common coal in producers, and also to support the combustion of the gases thus produced in hot-blast stoves. The stove efficiency is due to the positive supply of air and gas under pressure, which makes the combustion independent of the vagaries of the chimney draught. The higher thermal value of coal producer gas, when burnt in fire-brick chambers, ensures a higher temperature of the stoves, in addition to the higher thermal recuperative efficiency owing to the absence of lime dust. The new system of power production, the author submitted, might, when fully developed, have an important bearing upon the question of this country being able to withstand a fierce onslaught of competition.

At the last monthly meeting of the Glastonbury Town Council, the appointment of Mr. John Bishop, as Secretary of the gas undertaking, was sealed. Mr. Bishop was Secretary of the Gas Company, and was compensated on leaving their service when the works were transferred.

TECHNICAL RECORD.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

The 127th Quarterly Meeting of the Institution was held on Saturday, at Grantham, under the presidency of Mr. CHARLES WOOD, F.C.S., of Bradford.

The members made the journey to Grantham in two sections; one party arriving there on Friday evening, and the other about noon on Saturday. The advance party had an opportunity of visiting the gas-works, under the guidance of Mr. R. G. Shadbolt, who, later in the day, submitted a short paper, in which he gave some interesting particulars of the works and undertaking with which he is connected. A visit was also paid to the works of Messrs. R. Hornsby and Sons, Limited, the well-known agricultural implement makers and general engineers. These works, which cover 40 acres, give employment to about 2000 men, and are equipped with all the most up-to-date machinery and appliances for the production of the firm's specialities. The time at the disposal of the party did not allow of an inspection of the whole establishment; and attention was consequently confined to some of the principal sections of the general engineering works, through which the members were conducted by Mr. Henry Batty, Secretary of the Company, and Mr. John Tinn, Works Manager. The chief specialities turned out at the engineering works are oil-engines, water-tube boilers, and high-class steam-engines. Perhaps the most notable feature in connection with the firm's business in recent years has been the rapid development of their trade in oil-engines. The manufacture of these engines is now carried on in six large shops, and further extensions are in progress. The water-tube boiler department also forms an important branch of their trade; and the firm have orders in hand for boilers to evaporate about 24,000 lbs. of water per hour. A feature of special interest was the arrangements for driving the machinery, automatic tools, and cranes by electricity; the requisite power being obtained from two dynamos, giving 200 kilowatts each, or a total of about 500 B.H.P.

After lunch, the members were conveyed in coaches to Belvoir Castle, the seat of His Grace the Duke of Rutland, and spent an hour or so in the inspection of this interesting mansion. Returning to Grantham, the party had tea at the Angel and Royal Hotel, after which a short business meeting was held.

THE BUSINESS MEETING.

At the opening of the proceedings, Mr. Shadbolt said he would take the opportunity to offer the members, in the name of the Grantham Gas Company, a hearty welcome to the town; and he hoped they had all enjoyed their visit.

The HON. SECRETARY (Mr. J. Wilkinson, of Drighlington) read the minutes of the last meeting, which were unanimously adopted.

VOTE OF CONDOLENCE.

The PRESIDENT said the next duty they had to perform was a very sorrowful one. No doubt all were aware that since the last meeting they had lost, by death, three of their members—viz., Mr. John Cockroft, of Littleborough, Mr. John Chadwick, and Mr. Frank Barrett, who, he was sure, were known to all of them. He wished to propose that a vote of condolence be passed with respect to the deaths of these three gentlemen.

The members signified their assent to the proposition in the usual way.

INTERCHANGEABLE METER-UNIONS.

The next item on the *agenda* had reference to the question of interchangeable meter-unions.

The PRESIDENT observed that, as this matter had been recently discussed, and, he thought, was in a fair way to being settled by a Joint Committee of the Gas Institute and the Institution of Gas Engineers, he did not think there was any occasion for them to have any discussion upon it that day. The question seemed to be now practically coming to a settlement, and in such a way as would be satisfactory to everybody.

PAPER BY MR. SHADBOLT.

Mr. SHADBOLT submitted a paper entitled "Grantham and its Gas Supply," the main portions of which are given elsewhere.

The PRESIDENT proposed a vote of thanks to Mr. Shadbolt for his paper, and for the work he had done with the object of making their visit a success. He did not think they had had a more enjoyable outing for a long time past.

Mr. WILLIAM CARR (Stalybridge) seconded the motion, and remarked that it needed no words of his to commend Mr. Shadbolt's services to their appreciation. It had been throughout a most interesting visit.

Mr. SHADBOLT, in responding, said he much appreciated their kindness in according him such a hearty vote of thanks; but with regard to the arrangements for the visit, he did not wish them to think all the credit was due to him, as a small Sub-Committee, consisting of the President, the Hon. Secretary, and Mr. Mellor, had been appointed to make the necessary arrangements, and had taken a great deal of trouble in the matter. He had long looked forward to a visit from the Institution. He was pleased to see such a large attendance, and was deeply grateful for the manner in which they had supported him in his own town.

Mr. W. S. HADDOCK (Warrington) proposed a vote of thanks to Messrs. Hornsby and Sons, for the facilities they had afforded for the visit to their works, and in doing so, observed that they were all very much impressed with the machines and appliances they had seen there; and he trusted that the energy and ability displayed by the firm would bring them still greater success in the future.

Mr. W. W. HUTCHINSON (Barnsley) seconded the motion.

Mr. R. BRIDGE (Doncaster), in supporting the proposition, remarked that Messrs. Hornsby had for years been the back-bone of Grantham.

Mr. BATTY, responding, said it had given the firm great pleasure to accede to Mr. Shadbolt's request that the members might be allowed to visit the works. Their General Manager, Mr. David Roberts, had intended to join them, but was prevented by other pressing engagements from doing so. He had, however, left instructions that all facilities should be allowed for the visit. He thanked them on behalf of the firm for the way in which they had expressed their appreciation of what they had done.

Mr. TINN also briefly responded.

Mr. SHADBOLT explained that Dr. Jeans (the only original shareholder left in the Gas Company), who was getting well on to ninety, and who took a keen interest in the work of Institutions like theirs, would have liked to be with them, but the state of his health would not permit it. He, however, sent, through him (Mr. Shadbolt), his heartiest good wishes.

The proceedings then closed.

WAVERLEY ASSOCIATION OF GAS MANAGERS.

Half-Yearly Meeting at Musselburgh.

The members of the Waverley Association of Gas Managers held their Eighty-first Half-Yearly Meeting in the "honest toun" of Musselburgh last Thursday. The meeting was held in M'Laren's Café, overlooking the historic links of the town—one of the favourite resorts of the lovers of golf for many centuries. It was found, on assembling, that, on account of a serious illness in his family, the President (Mr. A. C. Young, of Kelso) had been, at the last moment, prevented from attending. Mr. A. Bell, sen., of Dalkeith, the last Past-President, was called upon to take the chair, as he had done in succession on the occasion of the two previous meetings. There was an exceptionally good attendance of members and friends.

The CHAIRMAN, opening with the remark that he had apparently become the permanent President of the Association, went on to express his regret at the position in which Mr. Young was placed. He suggested that, in the circumstances, the meeting should send a sympathetic letter to Mr. and Mrs. Young.

In the course of the proceedings, the speakers made feeling reference to the trying position in which Mr. Young was placed, and, before separating, the members instructed the Hon. Secretary (Mr. Laurence Bell, of Innerleithen) to prepare and forward such a letter as was suggested by the Chairman.

The only formal business on the *agenda* was soon disposed of; this consisting of the reading and approval of the minutes of the previous meeting, held at Innerleithen last April, and of the fixing of the next two meetings of the Association, to be held, the one in April in Kelso, and the one in September at Portobello.

THE PRESIDENT'S ADDRESS.

The following inaugural address by the President was read by Mr. H. O'CONNOR, of Edinburgh:—

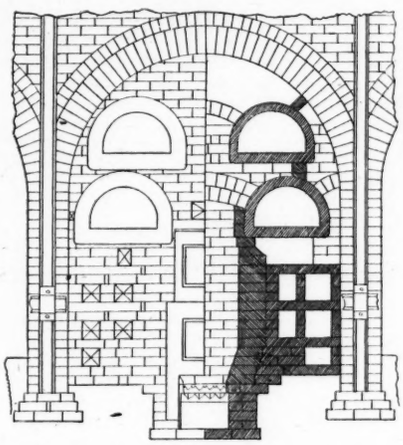
Gentlemen,—In looking round for a suitable subject to introduce to you for discussion, I have realized, especially on searching the records of the Waverley Association for the past few years, how difficult it is to bring before you something that is new. Of late we have discussed the general working of the gas business, from the retort-house to the consumer's burner, and the belief has been forced upon me that I should confine myself rather to one particular part of our machinery. Having come to this conclusion, it occurs to me that you would expect me to treat of something of which I might have a unique experience; but here, again, I have met with difficulty, because, on looking back, I seem to have had a new special care with each season since I first became a gas manager.

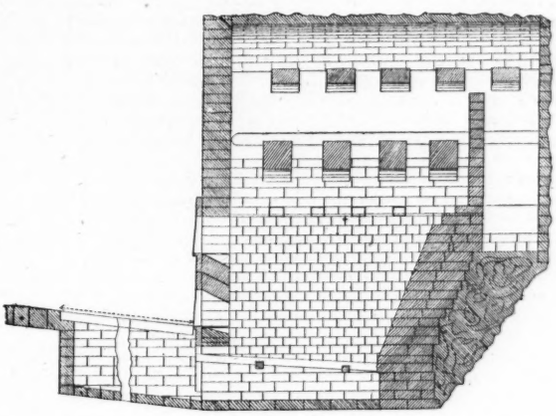
While I was at Auchterarder, perhaps the chief feature of my management was the introduction of the Peebles oil process and regenerator furnaces; and during my sojourn in Maybole, it was regenerator furnaces and the reduction of leakage. I might tell you of how, in Maybole, I was able to reduce the coal bill by at least one-third, while increasing the sale of gas by a million cubic feet; how I took up my duties there on the 1st of June, and had to erect an entirely new retort-bench, ironwork and all, and have this ready for making gas in time to spite the last retort of the old bench that fell to pieces about the middle of August; how I put three men on the streets, and kept them there for four months searching for leakages of gas that were supposed to be a day consumption in the factories; how, during a week's heavy rain, I had a man on the main traps pumping water, who durst not leave off for half-an-hour even to take food; and how, at an elevation of

200 feet above the works, and a mile away, I found the water getting into the mains fast enough to aërate the gas, and convert the jets in the adjacent houses into beautiful flat-flame bunsens, barely visible in daylight. I might speak of how in Kelso we have had the usual exhibition of cookers, resulting in the flooding of the town with these desirable adjuncts to the household; of the extension of the use of coin meters; the laying of 80 tons of trunk and subsidiary mains; the purchase of three acres of ground to provide room for immediate and prospective extensions; the erection of additional coal storage; an extension of the condensing plant; the erection of a station governor and a set of four 20 ft. by 14 ft. purifiers; the erection of new arches for four ovens, and filling them with four retorts in each setting for gaseous firing; and last, but perhaps not least, of how we have the best-lit town on the Borders, fully one-third of the lamps in the streets being fitted with No. 4 Kern incandescent burners, the upkeep and lighting of these being directly under my control.

I hope I shall meet with your approval in having finally selected for your consideration the construction of a gaseous-fired oven of four retorts upon economical lines. I firmly believe that this part of our plant has had more influence in cheapening the gas supply than any other branch of gas-works administration; taking precedence, in point of value in the gas industry, even of the Welsbach mantle. In treating of the construction of a regenerator furnace, I wish to keep the financial aspect fully in view; the cost being a serious consideration in a small gas-works. To adopt a "patent" or "standard" oven, such as we see advertised, is, as some of us are painfully aware, quite outside our reach, on account of the expense, not only of the first erection, but of the renewal of the retorts in due season. It behoves us to design something for ourselves that will give a good result without spending much money; and this can be done.

I have prepared a drawing of the oven that I have designed and erected in Kelso; and my Company get as good (if not better) results with this as can be had with any more costly setting. Perhaps I may be excused for directing your attention to the





extreme simplicity of the principles of gaseous firing. First, we have to produce the carbonic oxide gas (CO), which requires simply a deep furnace or pot, and the maintenance of a layer of hot fuel at least 2 feet, but better 3 or more feet, deep; secondly, we want a volume of air (secondary air) for the complete conversion of the carbonic oxide into carbonic acid (CO_2), thus completing the combustion of the fuel begun by the primary air passing through the deep mass of fuel in the pot; thirdly, we wish to heat this secondary air to as high a temperature as may be economically possible before it comes into contact with the gas leaving the fuel; and, fourthly, we utilize the heat of the waste gases, before they finally leave the bed of the oven, to heat the secondary air, and we thus allow no heat to be wasted in the main flues or in the stack.

We have, therefore, a deep furnace or gas-producer and a set of waste-heat flues and secondary-air flues running side by side; the air extracting heat from the waste flue, and bringing it back to the inside of the oven. The fact should be borne in mind, that we can get no greater quantity of heat from the conversion of coke into carbonic oxide first and then into carbonic acid by addition of secondary air than we can obtain from the direct combustion of coke into carbonic acid. It is not volume, however, but intensely high temperature, that we wish to obtain; and we want that heat to be in direct contact with the surfaces of the retorts, and to be kept there as long as possible. In the direct-fired oven, we must maintain a strong draught to raise the fuel to incandescence, with the result that the hot gases are rushed through and past the retorts, and escape into the stack before the proper amount of service has been performed.

Any very complicated arrangement of flues is attended with grave risk of bye-passing the air into the waste flues through leaky joints; the temperature being raised there instead of in the inside of the oven. One of the chief advantages of this setting is the larger selection of coal it gives us for firing purposes. It enables us to use a coal having a very poor coke, and, of course, this class of coal is considerably cheaper than that producing a so-called "good firing." We are asked as much as 20s. per ton this year for cannel that produces a good coke, whereas we get for 16s. a ton coal with a higher illuminating power, but yielding a coke that is unsaleable to the public. I use 60 per cent. of the latter class of coke in my furnace.

Sometimes I find it advantageous, from a financial point of view, to use as much as 25 per cent. of shale for enriching purposes. The residue from this we put into the fire, and burn off what carbon there may be in it. We clean the furnace every twelve hours, and there is usually about 15 inches in depth of clinker or ash to remove in that time. The hot fuel overhangs while the ash is being taken out, and is then dropped to the bottom of the pot by means of the clinkering bar. A scoop is used for pushing the hot coke direct from the retort into the furnace; the door is closed, and combustion goes on at once, there being no loss of heat in cleaning, as there is with the shallow fire.

The construction of this furnace is so simple that there seems no excuse for any of us working on the old lines; and I cannot conceive any reason why there should be an old type in existence at this day, unless it be that we are apt to be led into thinking that the erection of a successful regenerative setting is a very difficult and hazardous undertaking, and feel inclined to leave it in the hands of a professional retort-setter, and then, perhaps, have to give up the improvement entirely because the directors object to the expense.

I have tried to make as clear as possible on the drawings my method of arranging the flues and the general design; and I shall be pleased to think it may be the means of helping any young member who may be designing an oven for himself. The drawings are to scale, and measurements can easily be taken off. My custom is to get a bricklayer from a master retort-setter, and set him to build from my plans; and I buy the brickwork and ironwork direct from the makers. I superintend the work as it proceeds. Careful looking-after is very essential, as a wrongly-constructed flue may ruin the working afterwards. Referring to the drawings, you will note that part of the secondary air is admitted below, and at the back end of, the bottom retorts, as I have found the heat to be very intense above the fire-box; and by dividing the combustion in this way, I obtain a very equal temperature throughout. The light angle-iron bars are very useful should there be any difficulty in getting the primary air through the fuel in the producer; a slight shake being sufficient to get quit of any fine ash that may gather when using particular kinds of coal.

There is little building underground. All the flues are above the floor-line, and can be easily cleaned from the front. We charge, when not pushed, with 3½ cwt. of coal every four hours (the retorts measure 22 in. by 14 in. by 9 ft. 6 in. over all), and we get 10,000 cubic feet per mouthpiece easily. When we are pushed, we charge 3 cwt. every three hours, and have often had a make of 11,000 cubic feet per mouthpiece for days on end. I am not at all surprised to hear of a Border manager having obtained 12,000 cubic feet per diem from a costly patented oven when working all cannel, when this simple setting gives me such results as I have stated.

About one-and-a-half retorts of fuel out of the four is needed for the furnace. This consumption is small when you consider that there is present as much as 12 to 15 per cent. of ash. I do not believe in wire-drawn charges; I prefer charging full up to what the retort will work off. I thus get a high illuminating power and a greater economy in fuel, and am content with 9800 cubic feet per ton of coal on the year's working. All our charges are weighed; and I adhere rigidly to systematic charging "on the strike of the clock." We received £260 last year for coke sold locally.

The fire-box of this setting comes out independently of the flues for renewal, and we can at the same time reach these flues and point up any leaky joints that may exist. I have just renewed the fire-box of an oven, and put in four new retorts for the sum of £21, inclusive.

Discussion.

The CHAIRMAN expressed the obligation of the members to Mr. O'Connor for having so kindly read the address to them. He thought that there was sufficient food in it for a very worthy

discussion. He hoped everyone would have something to say on a subject which was of interest to all managers, and especially to the managers of small works.

Mr. W. B. M'Lusky (Perth) said that, at their last meeting in that district, he referred to Mr. Young's work as having fulfilled his highest expectations. Mr. Young had been getting about 21 cwt. of coal carbonized per retort per diem, and a yield of 9800 cubic feet of gas per ton. He obtained 10,000 cubic feet per mouthpiece per diem, which was 40,000 cubic feet per oven. There were many works with six and eight retorts in an oven where they were not producing more than 7000 or 8000 cubic feet of gas per mouthpiece. Mr. Young was thus, they could see, obtaining nearly as much gas from four retorts as some were producing with settings of sixes. Therefore they could not afford to put aside that setting because, on the surface, it appeared to be a very simple thing. There was one particular feature of the setting which was, perhaps, new. That was the introduction of part of the secondary air under the bottom retort. It did not come out very distinctly in the diagram; but there was a brick in the flue, by means of which the air could be adjusted. If he found that he could work up the air better above the fuel-bed, he closed up the flue; but they could understand that with the flue open, and with such a large body of fuel in the furnace, it was hardly possible, in the setting, to burn the carbonic oxide without having a little air introduced. The President would know the setting of Mr. William Young, of Peebles, practically on the same lines; and he had never, in all his experience, seen a setting which gave such good results. He believed it was in use in Peebles.

The Chairman: I have it too.

Mr. M'Lusky said that, unfortunately, the setting which he had was a little contracted in the flues, and it had been displaced by that setting, which was giving, all over, equally good results, if not better. In the address, reference was made to a Border manager having obtained 12,000 cubic feet of gas per mouthpiece. That was a fact. When Mr. Walker was in Berwick, he obtained 150,000 cubic feet of gas per day from twelve retorts. It seemed surprising; but he kept that up for two months. Mr. Walker sold 92 per cent. of the 12,000 cubic feet; he would be glad to give away the other percentage if he could get the same quantity of gas. Mr. Walker was working at the time with a Hislop setting. He was mixing 20 per cent. of the well-known Lothian second-class cannel, yielding about 11 per cent. of ash, with a larger splint coal parrot. Mr. Young was using 25 per cent. of shale, containing about 14 per cent. of ash; 35 per cent. of cannel, containing, probably, 81 per cent. of ash; and 40 per cent. of splint, containing, perhaps, 4 to 7 per cent. of ash. Mr. Young worked the ash up till the bottom bar was black, and he then raked it out. He had no clinker, and he had always an open fire. Looking to the other side of the question, however, Mr. Young referred to the danger of bye-passing with standard or patented settings. He thought it would be a mistake if they allowed it to go forth that there was any serious risk involved in the use of standard or patented settings, because short-circuiting took place, less or more, according to the quality of the work. Mr. Young had carefully superintended the erection of his settings; and if they did the same with patented settings, they would get similar results, and have no short-circuiting.

Mr. A. Yuill (Alloa) thought that the Waverley Association—the parent Association of Gas Managers—set a good example to other Associations in discussing the remarks of their President, because, in some cases, the address of the President, when published, bore the stamp of authority which it did not warrant. Mr. Young's setting was really simplicity itself. He had always felt that what might be termed an elaborate retort-setting was not well suited for small works. Those who had had experience with the newer forms of settings had also had experience, as Mr. M'Lusky remarked, of short-circuiting, more especially of the primary air as it went into the combustion chamber. In order to get over this difficulty, he had been in the habit of covering the ports with tiles, the joints of which overlapped each other. He had always found that one of the great difficulties to be got over in short-circuiting was the tendency of the oven to expand, which it did mostly in a lateral way. The method in which he placed his covers got over this to some extent. Mr. Young, while he had command of the secondary air and the waste gases leaving the furnace, had no command of the primary air. If they wished to have a well-regulated furnace, he considered they ought to have command of the whole three, because there was just the possibility of their allowing a much larger quantity of air to pass in as primary air than they would be able to consume. The test he generally made to determine this point was to have an opening made at the soffit of the arch. At this point, they must neither have the gas blowing out nor a vacuum—they must have the air equally balanced; and he found that he got the best result there. He did not wish to go into the question of how much gas could be taken out of the coal, because that was very much a matter of circumstances.

Mr. W. Blair (Helensburgh) said he could endorse nearly all the author had said. The setting was almost exactly similar to one that he put in at Haddington about eleven years ago. He would advise any who were working with a direct-fired system to adopt something as nearly approaching it as they could. He had had experience, since leaving Haddington, of full regenerative settings; and he was quite certain that he got as good results from those he had first. They were settings of threes that he introduced first; and the results he got from them warranted him in putting in fours. They had the danger of short-circuiting in all forms of regenerative settings; it all depended on the care which was exercised in the fitting in of the furnace. He got an average lifetime of about 9 million cubic feet per mouthpiece—practically six years' working—before renewal. He did not know if there was any other setting that could give a higher lifetime or a better record, considering the intermittent working they had. They often had to hang up for twelve hours, and in that way they could dispense with Sunday labour. Mr. Young did not say whether he used water or steam under his furnace. Having no steam-boiler, he converted water into steam by means of 2-inch tubes in the main flue. He found this to be of great advantage, as it kept away clinker, and the bottom of the furnace-door would be so cool that they could rake out the ash with their hand. It practically doubled the lifetime of the setting.

Mr. D. Vass (Airdrie) thought that Mr. Young was to be complimented on the results he obtained. His experience was that with twos, threes, or fours, he could get up the heat splendidly with an open fire, but that the loss of heat during the time of cleaning set it back so much that they were quite justified in spending some money in having a deeper fire. A direct-fired setting would not compare with that one in fuel, nor would it compare in the durability of the retorts. And so he thought it would pay anyone who had to do with small works to consider the durability of the retorts and the saving of fuel. He thought Mr. Young must have omitted to show that he used steam, because he could not see how he could get a sufficiently open fire without the use of steam, or introducing water to form steam.

The Chairman remarked that the presence of the angle-iron bars showed that he used water.

Mr. H. O'Connor (Edinburgh) said he recently designed a setting with three retorts very much on the same lines. The greatest difference was that he regulated and partially heated the primary air before it came in. He did not know that it was any advantage to heat it, but the regulation of the quantity should be. He thought the point with regard to most of the patent settings was that they required special bricks to be made for them. That was where the expense mainly lay. These special bricks were, no doubt, intended to prevent short-circuiting—the air getting into the waste flues direct, instead of passing into the combustion chamber. If they did not regulate the primary air, they would have a much greater quantity of carbon dioxide, and they would be consuming their fuel in the furnace—burning the furnace walls and bringing them down—instead of having it among the retorts, where it ought to be. As to the durability of the retorts, in a regenerator they only formed from a quarter to half of the total heat in the furnace; the remainder was formed in the combustion chamber. Mr. Young mentioned a layer of hot fuel at least 2 feet deep. This was certainly the least that it could be worked with. It was not wise to allow the fuel to get so low as that. The depth of the fuel was an advantage, because they would the more certainly have the carbonic oxide at the bottom converted into carbon dioxide when it reached the top. At the same time, they could only burn the quantity of fuel for which they had air at the working inlet. They might put in twice the quantity of fuel, but it would not burn; only the quantity would burn for which they allowed oxygen to enter, through the primary air. Mr. Young mentioned that in direct-fired ovens the hot gases rushed past the retorts. Not only so; but when they admitted oxygen into the furnace, they also admitted nitrogen—an inert gas which took up a large amount of heat—and something like double the quantity of heat was required which would be necessary in a regenerative furnace. He did not quite agree with the arrangement for putting the secondary air in at the back of the retort. It seemed to him that it would be better to get the heat round about the retorts by an increased number of secondary air inlets in the combustion chamber. He tried to keep the secondary air inlets as much as possible under the arches carrying the retorts. He preferred to have it in that way, because, as the two gases came up and met, they were baffled by the air and spread. But, of course, the regulating of the secondary air inlet under the bottom of the retort overcame a great deal of his objection to the opening there, because, if it were found to be working too much, it could be closed up. But, there again, it was only allowing the carbon monoxide to pass away to the chimney unconsumed. There was no doubt that charging the retorts full was the right thing to do, because it left only a small space for the gas; and consequently as it was being made it was rapidly taken away from the retort, thereby preventing the carbon in the gas being converted into solid carbon on the sides of the retort, and allowing the illuminating portion of the gas to pass away with it. He thought that the paper by Mr. Young was a most admirable one. It caused discussion upon the details of a work which was one of the most important matters of the day; and it induced others to make use of a process which tended to save the fuel of the country, because there was no doubt it gave them more coke to sell, and thereby saved coal. If people would only try the use of coke for manufacturing purposes, they would be astonished. The difference in heat units between coke and coal was so small that it was a distinct advantage to use coke for heating purposes.

Mr. W. Thomson (Musselburgh) said he had not much to add to what had been said about these retorts; but he thought they were the right things to have, even in small works.

Mr. J. Richmond (Kilkenny) said, as regarded retort-settings, he could only endorse what had been already said. He did not

consider that among the advantages of regenerative settings was the production of a greater quantity of gas per ton; and decidedly there was a disadvantage in the matter of the cost of construction. But there was an advantage in them, totally due to the economy of fuel; and fuel was a marketable article of which at present, in Scotland especially, the value was not realized. Where he now was, they could obtain about 26s. 8d. per ton for fuel; and it was a nice thing to save a little upon it.

The CHAIRMAN said that the setting they had been discussing was, comparatively speaking, an old friend. The beauty of it lay in its simplicity and cheapness. Mr. O'Connor did not like the idea of mixing the secondary air with the effluent carbonic oxide under the retorts; but it was to be noticed that in a small gas-works, where the setting was contracted, the centre space was so small that, were they to let the secondary air into the combustion chamber immediately on the top, the local heat would become so intense that everything would be melted down. It had therefore been found advisable to take off a portion, at all events, of the carbonic oxide, and to burn it outside the furnace. He was pleased to learn that Mr. Young was getting such magnificent results. He thought they had had a very profitable discussion upon his paper. Nothing better could have been brought before an Association of managers of small works.

Mr. M'LUSKY moved that a hearty vote of thanks be given to their veteran member, Mr. Bell, for his services in the chair.

Similar compliments were paid to Mr. O'Connor for reading the address, and to Mr. Bell, the Hon. Secretary; and these gentlemen having severally acknowledged the compliments, the meeting terminated.

A short visit was paid to the works of the Musselburgh Gas-Light Company, where it was found that everything inside the walls was of a spacious description, and that the Manager (Mr. W. Thomson) had the place and the machinery and plant in it in the utmost good order.

Returning to the café for lunch, the chair was taken by Mr. Bell, who had on his right hand Mr. W. R. Herring, of Edinburgh. At the close of the repast, the health of the King having been drunk, Mr. J. C. Adamson, of Airdrie, proposed the toast of "The Musselburgh Gaslight Company." In a few well-directed remarks, he urged that it would be of benefit to gas companies, and to consumers, if the directors of such companies were to send their managers to Association meetings, and to pay their way. Mr. J. M. Thomson, one of the Directors of the Musselburgh Gaslight Company, in acknowledging the toast, reciprocated the sentiment, and said it would also be of benefit to directors to attend such gatherings, because they would then be able to pick out the best man for the post of manager.

The company then enjoyed a drive, in conveyances provided by the Musselburgh Gaslight Company, to Granton, where Mr. Herring very kindly conducted them over the new works which are being erected there under his charge.

Mr. BELL (Dalkeith), at the close of the visit, proposed a very hearty vote of thanks to Mr. Herring for his reception of them. They appreciated his kindness in welcoming them to the works. It was to them a liberal education to observe how carefully everything had been thought out in the production of works of such importance. He was confident that when the works were finished they would be of great beauty, as well as usefulness. He questioned if there was anything so perfect in Scotland.

Mr. ADAMSON seconded the proposal, which was cordially adopted.

Mr. HERRING briefly acknowledged the vote of thanks. He was, he said, very pleased—indeed, he felt quite flattered—by their coming there as an Association. He had every confidence in what they were doing there. They might be a little presumptuous, perhaps, but he thought that, after all was said and done, they would be able to show that gas had still a big future before it.

Bidding Mr. Herring good-bye at the gate of the new works, the company drove into Edinburgh, and dispersed at the east end of Princes Street, in time for the members reaching their destinations by the evening trains.

The new bridge which crosses the Tyne at Redheugh, connecting Newcastle and Gateshead, has been fully described and illustrated in recent issues of the "Engineer." The bridge carries the gas and water mains; and, owing to the assistance the Contractors (Sir William Arrol and Co.) received from the Engineers of the Gas and Water Companies (Messrs. W. Doig Gibb and A. L. Forster), they were able, during the erection of the bridge, to dispense with swivel and temporary joints for the mains. The bridge was designed by Messrs. Sandeman and Moncrieff.

With the view of advancing the consideration of the subject of water supplies and river pollution, the Council of the Sanitary Institute have been making arrangements to hold a conference in St. Andrew's Hall, Newman Street, W., on the 16th and 17th prox. In connection therewith, there will be an exhibition of models and the latest appliances used in the distribution and purification of water; and silver and bronze medals will be awarded. Visits will be paid to water-works in and around London. As the subject is one which closely affects the health of the community and the work of sanitary authorities, the Council have invited these bodies to send delegates to the meetings; and we learn that 300 have been already appointed. The Secretary of the Institute (Mr. E. White Wallis) will furnish particulars, on application at the Parkes Museum, Margaret Street, W.

GRANTHAM AND ITS GAS SUPPLY.

From a Sketch submitted by Mr. R. G. Shadbolt to the Members of the Manchester District Institution of Gas Engineers on their visiting Grantham, Sept. 14, 1901.

Mr. President and Gentlemen,—While extending the heartiest possible welcome to you to-day, I feel that something akin to an apology is due for diverting you so far from your usual course, and putting so many of you to serious inconvenience thereby. My only plea is that, having been the recipient of the highest honour you can confer upon a fellow member, and circumstances proving unpropitious for such a visit as this during my term of presidency, I have ventured to invite you here ere my active connection with the Committee terminates.

The ancient and historical town of Grantham possesses a charm distinctly its own, and is vastly different in character to many cities and towns represented on our membership roll. To deal with its past history, is a task too great for an occasion like the present; yet one can scarcely pass without touching, however lightly, upon some of its salient features and associations.

. . . . . .

Situated on the Great North Road, one of the main arteries of the country, the good people of Grantham were not slow to hear of the wonderful new light to be obtained from the burning of so-called inflammable air, when coal gas first made its public appearance. Nevertheless, it was some considerable time ere they made up their minds to adopt its use in their own town. So far as can be ascertained, Mr. Thomas Winter, one of the pioneers of gas and water affairs in Grantham, exhibited a sample gas-light about the year 1830. The gas was made in the kitchen range, stored in an improvised holder formed of barrels, and burned at night behind the fanlight over the doorway of that enterprising gentleman's dwelling. The light was a source of great wonderment and delight to the admiring citizens, and was doubtless in a great measure instrumental in bringing about the formation of a Company to supply Grantham with gas. This took place under a Deed of Settlement bearing date Oct. 21, 1833. The objects of the Company were stated therein as follows: "For the express object and purpose of manufacturing and producing inflammable air or gas, from coal, oil, or other materials, and of supplying therewith the town of Grantham, and the places adjacent, and also of manufacturing and preparing for sale, selling, and disposing of, any of the materials or substances arising, or to be made, produced, or obtained, from the making and manufacturing of inflammable air or gas, by and under the name, title, or firm, of the Grantham Gaslight and Coke Company." Of the signatories to the foregoing Deed of Settlement, only one survives; and, as is most fitting and proper, he occupies the position of Chairman of the Company to-day. Dr. Jeans's uninterrupted connection with the Company from its inception, has made him a prominent figure in all matters pertaining to the gas supply of the town. He is indeed a typical example of those veterans of the industry who have been in great measure instrumental in bringing it to its present healthy condition.

That the growth of the Company did not progress by leaps and bounds in the earlier stages, is but what might be expected. The following advertisement, culled from the "Stamford Mercury," will give some idea of the magnitude of its operations ten years from the commencement of its career:—

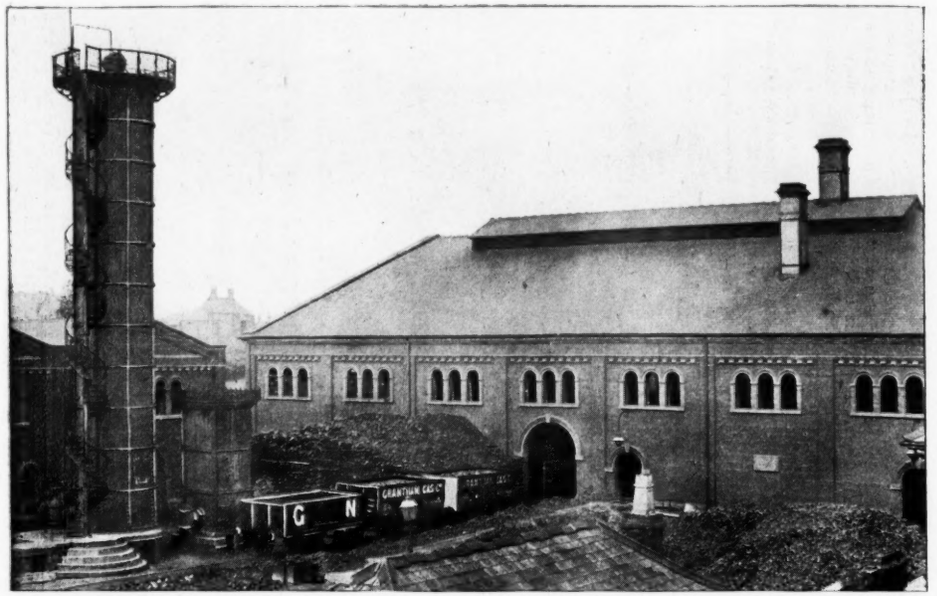
TENDERS FOR COAL.

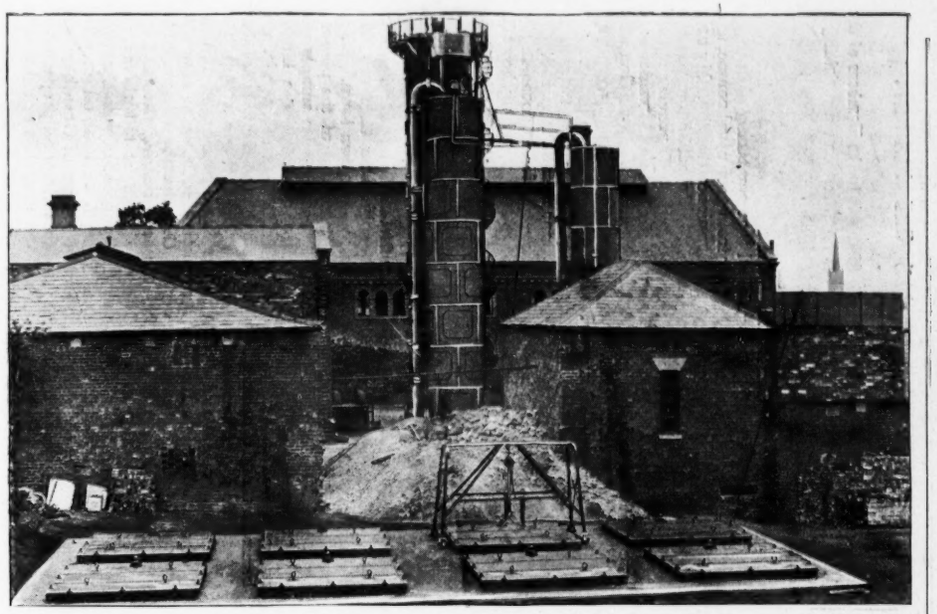
Tenders for supplying 400 Tons of the Best Silkstone Main Coals, to be delivered at the Grantham Gas-Works in such quantities as may be required, may be sent to my office, addressed to the Committee of the Grantham Gas Company, on or before Wednesday, the 28th inst.

THOS. WINTER,
Grantham, June 14, 1843. Clerk to the Company.

Steadily plodding along from an original capital of £6000, we find that by the year 1870 or so the sum of £25,000 had been invested in the undertaking; and the Company soon after took steps to secure a Special Act of its own, in which the promoters were successful—the first Grantham Gas Act receiving the Royal Assent in June, 1874. Equipped now with total capital powers of £50,000, the Company entered upon a new lease of life, and continued to perform its allotted task under this Act until 1900, when a supplementary Act was obtained, consolidating the old capital into stock, granting further capital powers (all on a 5 per cent. maximum basis), and extending the scope and area of supply of the Company. Such, briefly, is the financial history of the concern.

Members of the Institution are fully aware that such a meagre record of any gas undertaking conveys little, if any, indication of the real progress made or the effort and application involved. In the very nature of things gas plant cannot renew and extend itself so systematically as a natural organism, with its constant assimilation and accompanying replacement of exhausted tissue. The increase in demand made upon it may be of as gradual and natural a growth as you please. Not so, however, with the plant called upon to satisfy that growth, but rather the reverse; for at the least a manufacturing plant exists to some degree in a chronic state of degeneration, until the day arrives when the burden of demand can no longer be fully met, and a complete rehabilitation ensues. Such is not an isolated, but rather a universal and inevitable consummation, and such a one as we at Grantham are



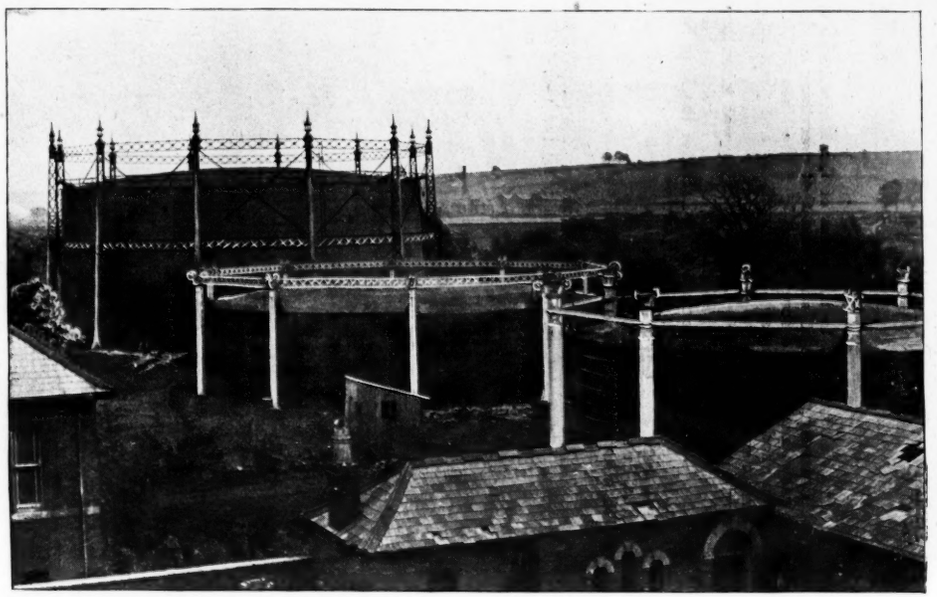


about emerging from. At such times, it is well to have an eye on the future ;and in our particular case, we have, as we think, paid due regard to that unknown quantity.

It is now between four and five years since the necessary work of reconstruction was commenced here, which, although not quite complete, is sufficiently advanced to show at a glance the lines adopted. Taking it as an axiom that the most successful engineering is that which best utilizes and conforms to local conditions and requirements, or, in other words, that best adapts itself to its environment, the introduction of excessive mechanical aids has been carefully eschewed. The next object in importance was the spreading out of the works generally, so as to permit of further extensions in the future without involving such a root-and-branch operation as the present case required; also to ensure a sufficiency of open yard space.

The accompanying illustrations will perhaps serve better to show the general arrangements and present stage reached than any detailed description. There is an outline plan showing the general arrangement of works when completed, and three views of the works as they stand to-day.

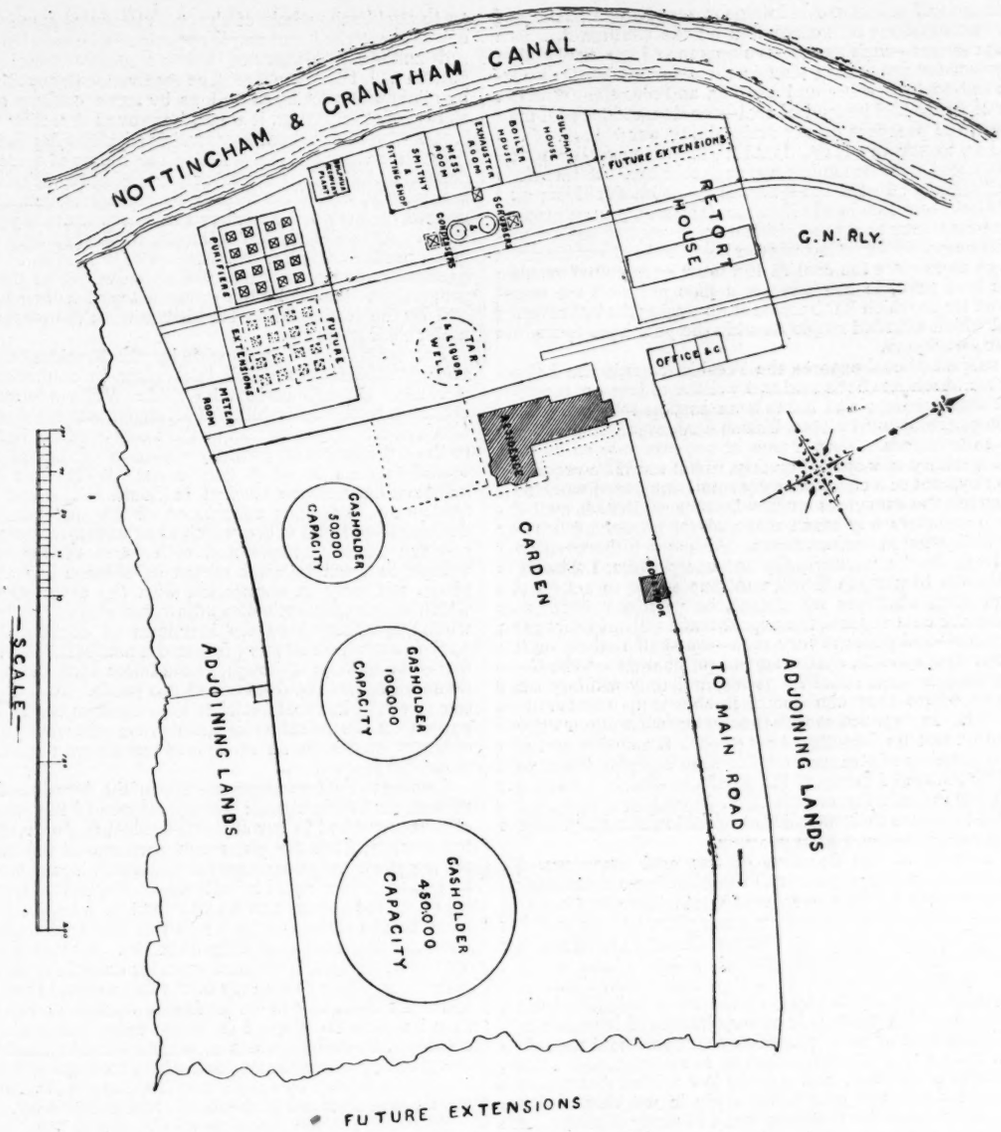
The retort-house is fitted with regenerative settings in through beds of eights, horizontal. The condensers are of the vertical water-tube type. The washing and scrubbing are effected by a Livesey washer and tower scrubbers. The exhausters are



of the rotary four-blade type, with engines combined and duplicated; and the purifiers of Green's type.

The nominal maximum day's capacity will be 1 million cubic feet. It may be noted that the coal is used direct from railway trucks—in fact, every part of the works from retorts to purifiers will, when complete, be served by railway communication. As the present make of gas is anywhere between 90 and 100 million cubic feet per annum, you will observe that a good margin remains wherewith to meet the growing demands for some time to come.

The district of supply presents no exceptional difficulties. Taken as a whole, it may be classed as distinctly "domestic," when compared with what so many of our members know as "manufacturing." Although not quite stationary, the population, according to the recent census, shows an increase of under 800 during the last decade—being an increase of about $4\frac{3}{4}$ per cent.; while, during the same period, the demand for gas has increased by fully 50 per cent., and this notwithstanding the reduction of gas used for manufacturing purposes by nearly 10 per cent. of the total sales. Undoubtedly this result is largely due to the increasing utility of gas to all kinds of domestic and trade purposes, and is simply an example of the vitality and general usefulness of the gas supply of the entire country. Of a population numbering



PLAN OF THE GRANTHAM GAS-WORKS.

just under 18,000, we have, in round figures, 2500 consumers, of whom about 25 per cent. are supplied through slot meters, and 35 per cent. use cooking-stoves—not to mention grillers, boilers, heaters, fires, engines, &c.

Cooking-stoves are supplied on simple hire, under agreement (a rent equal to 5 per cent. on the cost of the cooker alone being charged), and are fixed free up to 30 feet of piping. Gas-engines are supplied and fixed on the hire-purchase system, payment extending over five years. All other appliances are supplied at net cost, and consumers' ordinary burners are renewed free of charge. In a word, the general policy adopted in regard to consumers is to remove all initial obstacles possible; and as a result we find they are not slow to appreciate and respond.

The average consumption per consumer throughout—excluding public lighting—is 30,500 cubic feet per annum; and of slot consumers alone, 13,000 cubic feet per annum. The public lighting is done under contract with the Corporation; 390 lamps being employed, in 83 of which incandescent burners are used. Close to the gas office in High Street, are fixed one each of the Scott-Snell and Welsbach self-intensifying lamps, placed on opposite sides of the street for purposes of comparison. The general result and effect of the street lighting may best be judged by those who arrived overnight.

I must refrain from wearying you by the further recital of details familiar to most, and once more tender you my heartiest thanks for the honour you have done this ancient town, and the undertaking I represent, by your presence here to-day.

Liquefaction of Coal Gas.—A report is in circulation to the effect that a Mr. Strowger, of New York, who has a local reputation as a scientist, has discovered a process for liquefying ordinary illuminating gas. He claims to be able to compress it so that a small receptacle can be filled with it, and, with a burner attached, a light produced "far superior to ordinary gaslight." The commercial value of the invention lies in the facility for carrying gas about in any quantity for use as occasion may require.

THE CONSERVATION OF OUR COAL RESOURCES.

In the "JOURNAL" last week, reference was made in our editorial columns to the address on the above subject delivered by Sir W. T. Lewis, Bart., President of the Institution of Mining Engineers, in his capacity of President of the Mining Section of the Engineering Congress in Glasgow. In view of the interest attaching to the coal question, we give the principal portions of the address.

Referring to accidents in coal mines, Sir William contrasted the death-rate of four lives per million tons raised in 1900 with that of 19 persons killed per million tons raised in 1851—the year in which he entered the profession. Proceeding, he said: The improved arrangements introduced by our leading engineers and confirmed by legislation from time to time, which are gratifying from a safety point of view (which is, of course, the most important), have, however, imposed upon the colliery owners great additional expenses, so that the cost of producing coal has been permanently increased, notwithstanding the widely extended application of machinery. Those who have means of reference will find that, in addition to the greater immunity from accidents, our miners now also enjoy much better pay for the same amount of work; so that, on the average, comparing present operations with those of a similar kind forty years ago, there has been a permanent increase in the labour cost of coal getting of at least 20 per cent.—leaving entirely out of the calculation the recent prosperous times in the coal trade.

Dealing with foreign competition, the speaker pointed out that British coals, which formerly enjoyed a monopoly in the East, have, during the last fifteen years, been gradually displaced (in most of the markets east of Suez) by Australian, Japanese, and Native Indian coal; and he went on to say that, however much we may desire it, we are not likely to recover those markets in the future. Accepting this as a fact, and bearing in mind how

the Americans and others are bidding for supplying a portion of the requirements of our best customers on the Continent, where for various reasons—such as the development of the application of water power for generating electric force for all kinds of purposes in addition to lighting and heating, and also the extension of the use of liquid fuel instead of coal—the demand for coal may not increase, the prospect of our maintaining our volume of export trade is, to say the least, doubtful, more especially in the event of the coal duty becoming a permanent tax. It therefore behoves all connected with the business to be on the alert; and in order to hold our own in the Continental ports, it is of greater importance than ever that the British employers and their workmen should co-operate in adopting the best mode of working our collieries, so as to raise the coal in the most economical manner and in the best possible condition, and thus preserve the enormous export trade which has been built up during the last seventy years, and which afforded employment in the year 1900 to no less than 150,000 workmen.

On the subject of coal exports, the President made the following remarks: Much has been said and written of late on the subject of our coal exports; and it has been assumed by many that the foreigners are bound to have British coal, regardless of what it may cost the buyers. This, if true at all, can only be as to a very small quantity of a special quality, which could be produced by the employment of a comparatively small number of workmen. But, as regards the enormous preponderance of British coal exports, the purchasers buy much material for producing heat or power for utilization in various forms. Although hitherto our export coal trade has been principally non-competitive, I think it is a great mistake to assume it will continue so, or to act on the assumption that, whatever we charge, or whatever burden is placed upon our coal exports, the export trade will not suffer; for, sooner or later—and perhaps very soon—we shall realize, by the effect on our coal exports, that what the purchasers on the Continent require is so much fuel or power, and they will buy what they require where they can obtain it cheapest, whether it is British or not. In connection with the preservation of our export trade, it must not be forgotten how greatly the nation benefits through the number of steamers employed in carrying the export coal; and by reason of many of the steamers thereby securing a round trip, our manufacturers and others depending upon imports are enabled to secure their supplies at much lower rates of freight than would otherwise have been possible.

On the subject of the duration of our coal resources, Sir William directed special attention to the following points bearing upon the question: (1) The enormous waste there has been in the past, and continues at present in many places, in the working of the various seams of coal. (2) The loss through such a number of seams of coal being left in the ground, owing to their quality, their thinness, or their proximity to more valuable seams, and their being depreciated by the working of the more valuable seams. (3) The custom which prevails in many districts of lessees working out only the best or most profitable seams, without regard to the effect upon the thinner, inferior, or more expensive seams, under the same properties; and also the loss arising through such great quantities of small coal being made in working, and the proportion of small coal left underground in many districts. He called attention to the fact that another matter which conduces to a great deal of waste is the want of consideration as to the best order in which the different seams of coal underlying each other should be worked. Having regard to the very full information we now enjoy through the numerous sections of the mineral strata proved by pits and bore-holes in the whole of our coalfields, Sir William submitted that it would be a great advantage if a Committee of experts decided from time to time in each colliery district as to the most economical working of the whole of the coal seams in different collieries in each of our fields.

With respect to the practice of working the most profitable seams first, the President said: I am, of course, aware that the customs prevailing in the different coalfields, as to the terms and provisions of leasing, would in many cases render it difficult to carry out a different system or systems to those now being adopted. But, without admitting such objections as insurmountable, in any event such restrictions could in numerous cases be overcome, and certainly need not apply to the large areas of minerals unlet in the different coalfields. I have been so impressed for years past by the large number of instances of waste that have come under my observation through the many seams of coal that have been lost, owing to the working of the superior and most profitable seams alone, that I regard the matter of such supreme national importance as to justify special legislation, if this be necessary. In discussions from time to time on the improvidence of the practice of clearing out the superior coals alone, regardless of the effect upon the remaining coals in the property, it has often been urged that the short term of mineral leases, especially in some parts of the country, has forced the adoption of such measures, inasmuch as the lessees failed to see their way to redeem their capital within the term of the lease, except by working the best coals only. The short term of some mineral leases has, no doubt, had the effect complained of; and having regard to the increasing expenditure necessary for the winning of our deep coals in the various coalfields, and the necessity of expenditure in further extending the use of machinery in lieu of manual labour, it would be but just to the colliery owners, while it would at the same time be advantageous to the lessors as well as the country in general, if considerably extended terms of mineral leases were granted, so as to enable the whole of the coals in the properties taken to be efficiently worked, and ample opportunity afforded to the lessees to redeem the capital invested in their respective winnings. This suggestion will, I have no doubt, be received with anything but favour by mineral landlords, as well as by some colliery owners. But, as regards the former, it would be proved that they would, in the long run, greatly benefit by securing royalties depending upon the respective values of the whole of the seams of coals in their properties, instead of, as at present, obtaining royalties from the best seams only, while the thinner or inferior seams are left in the ground, through being rendered valueless or too expensive to work alone. As to the lessees' interests, while they may not obtain so much profit during the earlier years of the lease, there can be no question as to the increased value that would be given to colliery property in general by the permanency of a long term of lease, and by the lessees being enabled to work the whole of the coals under their property.

The next subject dealt with by the President related to the serious subsidences which take place in connection with coal working. On this matter, he said: While advocating special attention to the desirability of arrangements for working out the whole of the seams instead of the working of the best seams only, to the detriment and possible exclusion of several seams, I feel bound to refer to what may occur in the near future, when additional seams are worked in South Wales and similar coalfields—viz., a serious subsidence of the surface, and the great deterioration in its value, which must necessarily ensue. It may surprise those unacquainted with some of our Welsh mining valleys to learn to what extent subsidence has already taken place, not only in connection with the early steam-coal pits, which were comparatively shallow, but also in the deeper modern winnings, where there are instances of considerable areas of surface sunk from 10 to 15 feet and a number of other subsidences from 6 to 10 feet; although, in the latter case, the seams worked lie under a cover of from 600 to 800 yards. And it occurs to me that it would be most useful to the members of the Institution if papers on the question of subsidence were supplied from the different coalfields. The discussions thereon would have most beneficial results.

Coming to the important question of the duration of our supplies of coal, Sir William said: With reference to the number of tons of coal unworked in our different coalfields, this is, of course, easy to calculate, from the plans and sections of the seams proved, making the usual allowances for faults and loss in working. But, as I have endeavoured to indicate, the important question is how many of the seams can be assumed to be workable to a profit from time to time, and how much of the coal contained in the various seams can be usefully obtained. If the thin seams cannot now be worked while we have superior coals in thick seams to mix with them, I fear that many of the thinner and the inferior coals are much less likely to be profitably worked in the future, when they have to be worked in many cases either above or below abandoned workings which may have subsided, and be subject to water or any other causes, and when, to some extent, they will require to be won by deeper and more expensive collieries—all of which, of course, are elements of great uncertainty.

So much for the question of waste and loss, which, in my opinion, can and should be modified, so as to prolong our useful sources of supply. Then comes the question of our requirements as a nation—first for home consumption, and next for exportation, and the maintenance of our commercial position. As to our own requirements, there can be no doubt that a great saving ought to, and I hope will, be effected, if not immediately, most certainly when our coal output becomes more costly. It is, of course, dangerous to prophesy, as has been instanced by the estimates of so many of the eminent men who dealt with the subject in connection with the Coal Commission of 1871, which subsequently were found inaccurate; but we may, at all events, reasonably assume that, as our fuel becomes more costly, further attempts will be made to continue improvements in the direction of realizing a much nearer approach to the theoretical value of our coal, and thus secure further enormous economies.

Were it not that our fuel had been so cheap until recent years, many of the economies which have been introduced from time to time in our modern boilers, our best engines and manufacturing machines, and operations of various kinds, instead of being confined to modern works only, would have been generally adopted by all steam users and manufacturers, and thereby a great saving of our fuel effected. I may be pardoned for calling attention to the contents of a most valuable paper read at the last meeting of the Institution of Mechanical Engineers, at Barrow, by Mr. James M'Kechnie, wherein he sets forth the great improvements that have taken place in the boilers and engines of steamers during the last thirty years, by improved boiler and heating arrangements, adopting higher steam pressure, the compounding of engines, and increased piston speed, which has resulted in the average consumption of fuel per horse power per hour in steamers being reduced from 2·11 lbs. in 1872 to 1·83 lbs. in 1881, to 1·52 lbs. in 1891, and to 1·48 lbs. in 1901. It is hardly necessary to point out that such an apparently small saving, if applied to all the boilers in the United Kingdom, as well as to the steamers sailing under the British Flag, would represent millions of tons per annum; and considering that, even with these economical results, we are far from enjoying one-half of the economies which experts contend may still be made in the use of coal for steam purposes, and that we may confidently expect great advantages by the utilization of

inferior coals, by gas arrangements such as Professor Mond's and others, by the extension of the utilization of gas for manufacturing purposes, by the application of gas for the generation of electric power for lighting and heating, by the application of our water supply for the generation of electric power, and also by the application of liquid fuel for various purposes, enormous savings of fuel could be secured which would greatly reduce our consumption of coal. This, coupled with the husbanding of our coal resources by a substantial reduction of the waste I have previously referred to in the working of our coals, would, in my opinion, *extend the duration of our coal resources* so as to provide for all our requirements, and maintain our commercial position as a nation, while amply providing for the protection of our country, for a much longer term of years than any of the recent estimates I have seen on the subject.

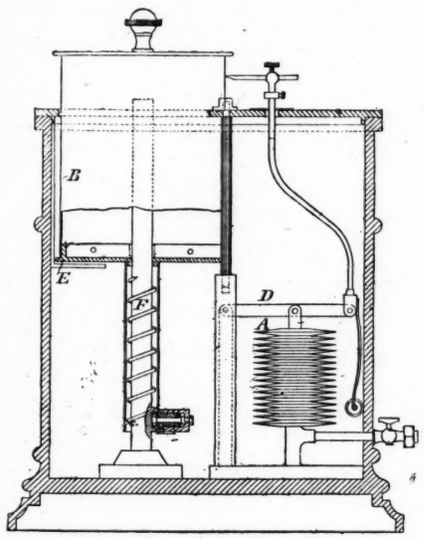
REGISTER OF PATENTS.

Apparatus for Mixing Gases.—Boult, A. J.; a communication from A. Molet, of Buenos Ayres. No. 13,404; July 25, 1900.

This is a rotary apparatus for mixing and supplying automatically—in a continuous manner, in previously determined proportions, and in proportion of the consumption of the product—two or more gaseous fluids irrespective of their nature and their pressure. It is based on the utilization of the difference of pressure of the gases to be mixed in proportion, for the purpose of obtaining the motive force necessary for the working; and it consists essentially of two drums rotatable together on the same shaft, of which one acts as a motor and the other as a suction device—each provided with a series of circumferential cells terminating at their opposite extremities in tubular prolongations or extensions arranged in opposite directions

Gas-Pressure Recorder.—Thorp, T., of Whitefield, and Marsh, T. G., of Manchester. No. 15,211; Aug. 27, 1900.

This is an apparatus designed to enable variations of pressure occurring at comparatively short intervals of time, during a period of some hours, to be read on a diagram of small size. It is more particularly intended for use with water-gas producers and carburetters.



As shown, there are a series of dished and corrugated metallic diaphragms A built up like an aneroid barometer, so as to form a longitudinally expansible and contractible chamber. The gas is admitted into the chamber through the pipe below. To the top of the chamber a stem is attached, connected to a lever D. The latter is fulcrumed on a pillar fixed on the bottom of the casing, and at its other end carries a bent rod, having a spring and roller at its lower end and at its upper end a clip for a pencil. The expansion and contraction of the chamber A is transferred to the pencil by the levers and rods.

The record is taken upon a sheet of paper lapped round a cylinder B (in the usual way), resting upon a toothed wheel E, to which is attached a tube or sleeve connected to a vertical coarse-pitched screw F fixed to the bottom of the casing, and having a prolonged neck on which the wheel E is guided. Two adjustable clips fixed to the projecting rim of the wheel are arranged to partly brake the wheel and prevent its acting upon the clock movement described below.

A long vertical pinion gears with the wheel E; and to the cover of the apparatus a clock movement is fixed, driving by a train of wheels a wheel that can be put into and out of gear with the pinion by means of a handle, the knob of which protrudes through the top of the case. When moved so that the wheel is in gear with the pinion, the clock will rotate the cylinder B round the screw F, and the roller will cause the cylinder to ascend or descend at the same time, so that the pencil will describe a helical line upon the paper on the cylinder B, when the pencil is at rest or the cock is closed. The cylinder is rotated at a comparatively rapid rate—ordinarily making a revolution in four hours, while having a diameter of 6 inches—so that variations in the pressure between very short intervals of time are readily apparent.

Coin-Freed Gas Apparatus.—Jackson, E., of Oldham. No. 3652; Feb. 20, 1901.

Inside the machine, and in close proximity to the slot or mouth through which the coin is to pass, the patentee proposes to place a magnet, so that the coin intended to be used to obtain the gas or other commodity from the machine, has to pass over, or come into contact with, the magnet. If it be a coin that is put in the machine, it drops into the receptacle intended for it, and the mechanism operates in the usual way. If, however, it be a substitute in the way of a disc or other piece of metal, the magnet holds it until a coin or another piece of metal is put in, when it is pushed along the magnet until it has passed over a second receptacle which is not connected with the mechanism of the machine. It is then released from the magnet and drops into the receptacle; and in this way prevents any fraudulent use of the machine.

Mixing Oxygen with Lighting or Heating Gas, either Previously Formed or Simultaneously Generated as Carburetted Air.—Dannert, F., of Berlin. No. 5149; March 11, 1901.

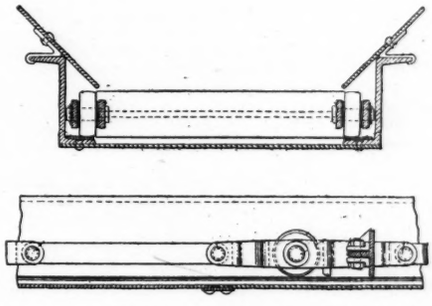
The object of this invention is to provide means for effecting an intimate and uniform mixture of lighting or heating gases with oxygen—consisting in passing the gases through porous bodies (as, for example, vegetable carbon or pumice stone), which have the property of condensing gases on their surface; the porous bodies, previously impregnated with oxygen, being inserted in a cartridge into which oxygen is supplied, and exposed later to pressure.

The main idea of the process is that the gas is forced to percolate through the porous substance "in the most finely divided state, and to enrich itself with oxygen automatically as required, whereby a normal mixture is invariably obtained—an object never achieved by supplying the oxygen to the gas in jet form."

Experiments made with the cartridges (says the patentee) gave the following results: A cartridge as described was put into a vessel containing gasoline or sulphuric ether, so that a portion of the fluid could penetrate into the carbon for about half its height. Air under pressure was forced through the cartridge, and had to percolate through the gasoline and carbon of the cartridge before its exit produced an air gas, slightly enriched with oxygen, "whose heating properties, when ignited, were greatly superior to those of ordinary gasoline air gas."

Coke Conveyors.—Cliff, W. D., and Sugden, F. C., of Leeds. No. 12,063; June 13, 1901.

This invention, relating to conveyors for incandescent coke from the retorts in gas-works, has for its object to produce easier running than heretofore, and consequently save power. There are two endless chains, each composed of two different forms of links—one a link cast or wrought in one piece having a roller path clearer and side bracket attached; the other a plain link. They are arranged alternately. The link may be described as a scraper or rake link made of iron or steel, and prepared to receive a runner or wheel. It is provided with lugs to which a scraper or rake is attached; and it also carries a projection in front which clears its path. The chains run along paths one on each



side of a trough, and at each end they pass over wheels by which they are operated. The trough (if of metal) is in one length or composed of segments bolted together. The scrapers or rakes are made of any suitable section, but preferably of T section, and are fixed transversely between two scraper or rake links (one in each chain) by means of rivets or bolts and the lugs. Hopper sides or deflecting plates are fixed on the side of the trough by means of lipped brackets.

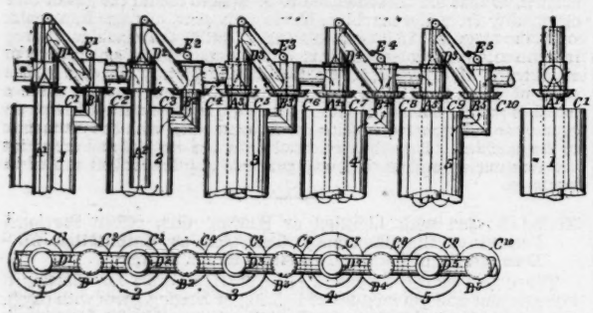
The action of the conveyor is as follows: The wheels at one end of the trough over which the endless chains pass are caused to rotate—thus transmitting a traversing motion to the chains along the trough. The coke is guided into the trough by the hopper sides or deflecting plates, and is propelled before the scrapers or rakes to its destination.

Purifying Gas.—Prégardien, J. E., of Kalk, near Cologne. No. 13,788; July 6, 1901.

In apparatus for purifying gas as usually constructed—in which single chambers are connected by means of pipes to form a continuous series—the patentee points out that there is the drawback that, for cleaning out single chambers, the whole series must be put out of use and the manufacture of gas interrupted. He proposes to enable single chambers to be cleaned without interrupting the process by inserting in each pipe connecting two chambers with each other, a double and single plug (which allows of communication between one chamber and the next, or shutting off this latter), and making connection with a pipe discharging into the main connecting-pipe above the plug.

As shown (p. 724) the inlet-pipes A^1, A^2, A^3, A^4, and A^5 and outlets B^1, B^2, B^3, B^4, and B^5, on the separate chambers 1, 2, 3, 4, and 5, are provided with plugs C^1 to C^{10}, of which either those of the inlet or outlet pipes must be constructed as double plugs. The inlet and outlet pipes are connected by pipes D^1, D^2, D^3, D^4, &c., above the plugs. The separate chambers are connected and disconnected by opening or closing the plugs of the inlet and outlet tubes. As one of the two plugs

is double, the connecting pipe will be closed or open simultaneously. The rising or falling of the lids of each two plugs belonging together, takes place by means of the common drums E^1, E^2, E^3, E^4, and E^5, on which are twice wound the chains or ropes of the closing lids in a contrary direction.



In the illustration the chambers 1 and 3 are out of operation; while 2, 4, and 5 are connected up—the gas taking the course indicated by the arrows.

APPLICATIONS FOR LETTERS PATENT.

16,268.—Klatte, R. O., "Regulating the working of gas compressors and the like." Aug. 13.

16,275.—Sugg, W. T., "Incandescent gas lighting apparatus." Aug. 13.

16,335.—Tatham, J. E., and Cope, J. L., "Gas-burners." Aug. 14.

16,356.—Fichet, P. A., and Heurtey, R. M. J., "Gas generators." Aug. 14.

16,440.—Simpson, W. M., "Liquid or gaseous fuel." Aug. 16.

16,449.—Oswald, T. H., and Bowman, F. E., "Gas-producing plant." Aug. 16.

16,491.—Gilbert, W. S., "Incandescent gas lighting." Aug. 16.

16,629.—The British Westinghouse Electric and Manufacturing Company, Ltd., "Internal combustion engines." A communication from E. E. Arnold and A. T. Kasley. Aug. 19.

16,630.—The British Westinghouse Electric and Manufacturing Company, Ltd., "Fluid-pressure engines." A communication from C. Robinson. Aug. 19.

16,661-2.—Hersey, S., "Washing or scrubbing gas." Aug. 19.

16,699.—Westinghouse, G., "Manufacture of gas." A communication from W. J. Knox. Aug. 20.

16,700.—Westinghouse, G., "Supply of heat to coking-ovens and the like." A communication from W. J. Knox. Aug. 20.

16,739.—Dunn, J., "Packing leaks in pipes." Aug. 20.

16,761.—Beilby, G. T., "Treatment of gases for the recovery of nitrogen compounds." Aug. 21.

16,827.—Edmondson, J., "Internal combustion engines." Aug. 22.

16,836.—Auld, J., "Pressure-regulating valves." Aug. 22.

16,894.—Pollock, J., "Valves for controlling the flow of fluids." Aug. 22.

16,909.—Haddan, H. J., "Mantles for incandescent lighting." A communication from J. B. De Lery. Aug. 22.

16,923.—Wright, G. E., and Sutherland, A. G., "Gas-meters." Aug. 23.

17,055.—Turner, A. E., "Fluid meters." Aug. 24.

17,059.—Goodwin, A., "Supports for burners provided with incandescent mantles." Aug. 24.

17,079.—Graf, A., "Gas-burner." Aug. 26.

17,093.—Berthold, C. E. J., "Automatic gas-lighters." Aug. 26.

17,125.—M'Callum, C., "Combined gas-stove and fire-lighting apparatus." Aug. 27.

17,171.—Cornell, E. B., and Alderson, W. C., "Making a fixed gas for lighting, heating, or other purpose." Aug. 27.

17,190.—Preston, F. G. P., and Mees, A. B., "Fluid meters." Aug. 27.

17,218.—D'Humy, P. R. de F., "Retorts." Aug. 28.

17,272.—Jenkins, W. J., "Conveyors and elevators." Aug. 28.

17,292.—Oswald, T. H., and Bowman, F. E., "Gas-producing plant." Aug. 29.

17,300.—Hislop, G. R., "Regenerative gas burners and lamps." Aug. 29.

17,310.—Scott, G. L., "Gas and other stoves." Aug. 29.

17,329.—Masters, A. A., "A combustible fluid for lighting and heating purposes." Aug. 29.

17,494.—Schniewind, F. W. C., "Manufacture of gas." Aug. 31.

17,507.—Scott-Snell, C., "Pressure system for incandescent gas lighting." Aug. 31.

17,510.—Schniewind, F. W. C., "Manufacture of gas." Aug. 31.

17,517.—Jones, F. J. C., "Making combustible gas." Sept. 2.

17,524.—Davis, W. H., "Incandescent gas-burners." Sept. 2.

17,528.—Wright, G. E., and Sutherland, A. G., "Meters for gas, water, and other fluids." Sept. 2.

17,559.—Verzier, A., jun., "Gas-furnaces." Sept. 2.

17,637.—Wolf, H., "Incinerating, shaping, and hardening incandescent mantles." Sept. 3.

17,646.—Haddan, H. J., "Gas-burners." A communication from J. Harris and S. H. Smart. Sept. 3.

17,659.—Jamieson, M. W., "Gas-engines." Sept. 3.

17,754.—Corbett, C. E., "Gas-fittings." Sept. 5.

17,786.—Ward, T., Coulson, M., and Clayton, R., "Gas-fires." Sept. 5.

17,792.—Shaw, A., "Rotary pumps, blowers, and the like." Sept. 5.

17,842.—Paterson, W., "Internal combustion engines." Sept. 6.

17,927.—Offenberg, M., "Regulating the pressure in gas-burners." Sept. 7.

17,936.—Boult., A. J., "Gas-lighting devices." A communication from P. Bardot. Sept. 7.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

Coal Statistics.

Sir,—I am much obliged by your enclosing me that portion of your issue of the 3rd inst. containing (under the head of "Editorial Notes") a criticism of my letter to "The Times" of the 31st ult., on the subject of "The Export of Coal," in which you question the correctness of my calculation in regard to economy in the home consumption of coal during the period dealt with in my letter. I fully appreciate your courtesy and consideration in affording me the opportunity, which I am glad to avail myself of, of replying to your criticisms.

I would at once point out that you are entirely mistaken in your assumption that the difference of 313½ million tons between the estimated quantities of coal given in Table III. of the Coal Commission's report and the actual results during the last 30 years was arrived at by any such intricate calculations as those you attribute to me; and that the consumption of coal per head of the population was not, as you imagine, the basis of my calculations. The figure in question, as a glance at the table which accompanied my letter in "The Times" testifies, was simply arrived at, without much effort at calculation, by merely subtracting from the larger and over-estimated quantity of 4368 million tons given in the Coal Commissioners' report, the actual and smaller quantity of 4054½ million tons used for home consumption during the period in question.

The only calculations alluded to in my letter are those relating to the period of exhaustion of the remaining coal supplies in the known coalfield areas, which conclusively show that, should the present export of coal (of 58½ million tons annually) continue to increase at the high average rate of 5½ per cent. per annum, maintained during the last 30 years, the coal exports alone would exhaust the 92,000 million tons in about 83 years, or adopting your figure of 90,000 millions, and excluding as workable all coal at depths exceeding 4000 feet, after deducting the 5010 million tons worked out since the date of the Commissioners' report, there would only remain 84,990 million tons, which it is needless to say would hasten this national catastrophe.

The consumption of 4·08 tons of coal per head last year, alluded to in my letter, does (as you point out) apply only to the population of the United Kingdom; and omitting that of Ireland—as the Coal Commission did in their calculations, on account of the disturbing effects of the constant decrease in its population which has continued since 1841—the home consumption per head in Great Britain last year would, as you point out, amount to 4·5 tons; and I am much obliged to you for the correction. You also state that the 4·08 tons for the United Kingdom, and consequently the 4·5 tons for Great Britain, is the highest point yet reached in the home consumption of coal in any one year. Assuming this to be so, I would point out this: It is still appreciably below the Commissioners' estimated figure for the 1901 decade—viz., 4·63 tons; the actual average coal consumption per head during the 30 years would be somewhere between the maximum of 4·5 tons in 1900 and the 3·96 tons at which it stood in 1871. But the differences between the estimated and actual quantities of home-consumption coal used in each period are summed up in the 313½ million tons in question, without any need of *per capita* calculations; and this difference I consider testifies to greater economy in the consumption of coal during the period in question.

That large economies in the home consumption of coal in this country have been effected since 1871 is unquestionable, more especially in connection with the iron and steel manufactures, where, as I have shown in a paper on "The Coal Question" read by me at the Royal Statistical Society, while in 1871 the iron and steel trade required 30 per cent. of the coal consumed in the United Kingdom, its requirements had been reduced to 16 per cent. at the time I read the paper in 1889, mainly owing to the introduction of the Bessemer and Martin-Siemens processes of manufacture; to which fact, and to the further larger coal economies effected during this period in the manufacture of pig iron, Mr. Bennett Brough, the Secretary of the Iron and Steel Institute, has drawn attention in his interesting article on "The Scarcity of Coal," which appeared a short time ago in the "Nineteenth Century Review."

There is still, however, admittedly, much room for further large economies in coal used for manufacturing purposes; and, speaking as a coal-mining engineer, the economies that can be effected by the use of mechanical appliances in "getting" the coal and the saving of waste in working will be still larger. The economies to be effected in the coal used for domestic purposes, to which your widely-read "Journal" has directed attention, are simply enormous.

As regards my having included as available sources of future supply all the coal at depths exceeding 4000 feet, to which you draw attention, I should state that this was done intentionally; my object being to show that, even if the entire coal resources of the kingdom were available, the period of their complete exhaustion, with a continuance of the high rate of increase of the coal exports which has been maintained during the last 30 years, would be reached before the close of the present century.

It only remains for me to briefly refer to your allusion to the work of the Coal Commission of 1866. The Commissioners, almost all of whom have now passed away, were, as the signatures appended to the report testify, among the most eminent and prominent men of their day, and in every way the most competent to deal with the various questions connected with the coal resources of this country, which they were appointed by the Government to investigate; and one of the most noteworthy features in their report is the care taken to make it clear that the results of their calculations as to the duration of our coal supplies will, to use their own words, "be subject to contingencies which cannot in any degree be foreseen." As regards, however, the great work the Commission so successfully accomplished, of determining the extent and amount of the remaining coal supplies of the United Kingdom, to which five years' investigations were devoted, I am glad of the opportunity afforded me, as a coal-mining engineer

well acquainted with by far the largest of our coalfields, of bearing testimony to the very thorough and complete way in which the investigations were carried out in the coalfield area I have alluded to, and to the great value of the work done, which for the first time has furnished reliable means of ascertaining very approximately the extent and amount of one of this country's most valuable assets; and if, as I gather from your reference to the subject, the appointment of another Royal Coal Commission is contemplated, the results of the investigations of the various Committees to whom this most important work was entrusted, which are given in the appendices to the report, and the plans and other data furnished, will prove to be of great value.

6, *Queen Anne's Gate, S.W., Sept. 7*, 1901. R. PRICE-WILLIAMS.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, Sept. 11.

(*Before Mr. Justice* JOYCE, *Vacation Judge.*)

The Welsbach Incandescent Gaslight Company, Limited, v. The United Chemical Works and Julius Norden, and in the Matter of Walter King.

On this item in the "Cause List" being reached,

Mr. BOUSFIELD, K.C., said he was instructed to apply, in this action, or an order for the committal, for Contempt of Court, of Walter King. He should not, however, need to trouble the Court at any length that day, as his learned friend, Mr. Neill, who represented Mr. King, was not ready, and desired an adjournment.

His LORDSHIP pointed out that there was another difficulty—viz., that the application ought to have been made to a Divisional Court. However, the Lord Chief Justice, who would be sitting next Wednesday, would deal with that point. He thought the attention of the Lord Chief Justice should be called to it.

Mr. BOUSFIELD said he would mention the matter.

His LORDSHIP: Subject to that, I think he will have no difficulty in disposing of the matter in five minutes.

Mr. BOUSFIELD said the difficulty could easily be got over by moving in one of the Chancery actions, instead of in the King's Bench action.

Mr. NEILL said further trouble might be saved by his mentioning that the newspaper in question [the "JOURNAL" for Aug. 27] had been withdrawn from circulation.

His LORDSHIP: You do not, then, claim to repeat the offence?

Mr. NEILL: We do not.

Mr. BOUSFIELD: Will my friend offer an apology?

His LORDSHIP: If Mr. Neill undertakes not to repeat the offence, might not this motion stand over till Michaelmas sittings?

Mr. BOUSFIELD thought not, as the matter was one of great urgency.

Mr. NEILL said he wished to answer the affidavits that had been filed by the Welsbach Company, and he was instructed that, in the meantime, his client would not issue any more copies of the paper.

His LORDSHIP thereupon directed the motion to stand over for a week.

Alleged Intimidation by Cork Gas Strikers.

At the Cork Police Court last Tuesday, four of the gas workers on strike—Jeremiah Madden, John Hunter, William Murphy, and John O'Brien—were summoned by John Daley, one of the employees who remained at work during the strike, for having wrongfully and without legal authority persistently followed him from place to place with a view of compelling him to abstain from doing what he had a legal right to do—viz., work for the Cork Gas Company. The case, it was explained, was brought under the 7th section of the Conspiracy and Protection of Property Act of 1875. The plaintiff and Mr. M'Grath, the Manager of the works, gave evidence specifying acts and occasions in corroboration of the charge. In the course of the evidence, it transpired that the former had been in the employ of the Company for 15 years. The hearing of the case was adjourned.

Failure to Supply Electricity to Private Consumers.

An important case affecting the liability of corporations to supply private consumers with electricity was heard at the Manchester City Police Court last Wednesday. Mr. S. Howard, a musical instrument dealer, of Oldham Street, was the complainant; and the defendants, the Manchester Corporation, were represented by Mr. Bell. Counsel for the prosecution stated that the complainant became tenant in June of premises which had previously been supplied with electric current. When he took possession, a month later, he found that the meter had been taken away. On the 9th of August he wrote to the Electricity Department for a form of application for the current. No reply was received; and, after several more letters, with no satisfactory result, the matter was placed in legal hands. A firm of solicitors wrote that the Corporation would be held responsible for loss of trade suffered by the complainant. The Secretary of the Electricity Department then wrote that the Committee could not connect the installation until they knew what energy could be supplied by their new station in Bloom Street. Counsel said the Corporation's real reason was that they were husbanding their resources to drive the electric cars. This, however, was no legal excuse, because under the Board of Trade Order of 1890 they were bound to supply private consumers with the current, provided their premises were within 50 yards of the main. In default, they were liable to a penalty of 40s. a day. Mr. Bell, for the defence, said the summons was bad, because the Corporation were stated to have failed to supply the current as asked for on the 9th ult. As a matter of fact, only a form of application was asked for on that date. Counsel for the complainant said that, if necessary, he would ask that the summons be amended accordingly. The case would certainly come up again. He was surprised at this shabby sort of defence. The summons was dismissed, but without costs.

After-Effects of the Cork Gas-Works Strike.

Last Friday week a gas-works striker named John McCarthy was summoned (and eventually fined 20s. and costs, or 14 days' imprisonment) for assaulting David Grant, a gas-fitter who it was said had remained faithful to the Gas Company, and was described as "a most inoffensive and respectable man." There was nothing so remarkable about the case as the freedom of language indulged in by the legal gentlemen engaged in it. Dr. Wynne—re-examining a witness said to have been present at the time of the assault—asked if the prosecutor was drunk on the occasion, when Mr. Julian (for the prosecutor) asked if that arose out of his cross-examination. Mr. Mayne (the presiding Magistrate) said it did not. The following colloquy then took place: Mr. Julian: I did not ask him anything about it, because I could not place much reliance on the account he would give of it. Dr. Wynne: A most impertinent observation, and in keeping with your whole conduct of the case. Mr. Mayne: Now, gentlemen, I won't allow this. Mr. Julian: It is most improper; but this little cur can't conduct himself. Dr. Wynne (rising and addressing Mr. Mayne): I have been called a cur. Are you going to allow me to be insulted by an ill-conditioned cad like this? Mr. Mayne: I cannot allow this. Let you take libel actions against each other. This is most improper language to use in a Court of Justice; and I regret very much to have heard it. Is the case over? The proceedings then terminated in the way stated.

Last Thursday, George Lane (another striker) had to submit to a heavier fine—viz., 40s. and 20s. costs for a similar offence. The complainant was John Driscoll, who had been in the employ of the Gas Company continuously for 45 years, and who asserted that Lane violently struck him twice in the face on the 10th inst. According to the evidence in defence, Lane is one of the most upright and inoffensive of men, and could not have behaved in the dastardly manner attributed to him; and it was declared that the assault must have been committed by someone else. As already intimated, the Magistrates had not much doubt as to who was Driscoll's assailant.

A Town in Darkness.—The small, if old, town of Coleshill, near Birmingham, was in darkness last week. The place is supplied with gas from works which are naturally on a small scale, and on Saturday, the 7th inst., the retorts were found to be so faulty that the holder could not be filled, and the supply of gas ceased.

Bingley and the Purchase of the Cullingworth Gas-Works.—Representatives of the Bingley District Council and of the Cullingworth Gas Company have now come to terms for the purchase by the Council of the undertaking of the Company. The price agreed upon is £9000, the Company to pay all legal costs of the transfer. At the conference previously held, the vendors asked £9000 and costs.

Reductions.—The following additional notifications of reductions in the price of gas has been announced: Brighton, 3d.; Cheltenham, 1d.; Colney Hatch, 3d.; Douglas (Isle of Man), 2d.; Falmouth, 4d.; Harrow and Stanmore, 3d.; Hexham, 2d.; Kirkintilloch, 7d.; Lasswade and Bonnyrigg, 5d.; Longton, 3d.; Lynn, 4d.; Milnthorpe, 5d.; North Middlesex, 3d.; Pontypridd, 6d.; and Sevenoaks, 4d.

Scaffold Accident at Clay Cross.—Last Wednesday, a serious scaffold accident occurred at the new gas-works being erected at Clay Cross by Messrs. R. & J. Dempster, Limited. Five men were on a scaffold inside the gasholder, about 22 feet high, moving a large iron pipe weighing about 3 cwt., when the whole gave way. George Brough, riveter, of Bilston, had a leg broken, and was sent to the Chesterfield Hospital; and the other men were much hurt.

St. Albans Gas Company.—At the half-yearly meeting of this Company last Tuesday, the Chairman mentioned that the increased cost of coal last half year was £1299; while the rise of 4d. in the price of gas only yielded an increase of £764. The market for coke and residuals was bad. A dividend of 5 per cent. on the consolidated stock was declared. The question of Directors' fees was then considered. The Chairman mentioned that the Company's business had nearly doubled since the Directors had been voted their present remuneration of £150, and they had had to re-build nearly the whole of their premises. Extra remuneration of £80 a year was voted.

Suicide by Gas.—A determined case of suicide is reported from Huddersfield, where a warehouseman named Harry Woodhouse, aged 31, who lived with his brother-in-law, Tom Mann, a mill operative, sought death, on Monday last week, with the aid of gas. He connected, by means of an india-rubber tube, a small stove to the gas-bracket in his bedroom, and placed the stove in bed. He was found dead under the clothes in the evening. Pinned to the mantelpiece downstairs was this note for his brother-in-law: "Do not bring a light upstairs; the gas is on. Simply tired of life." At the inquest, Dr. MacKenzie said the man had been dead a few hours. He had suffered from no illness for a long time, but had complained of pains in the head.

Suffocation by Gas.—On Monday last, Mr. Dennis Long, of the Sunderland Shipbuilding Company, Limited, was found dead in a bedroom at Conkleton's Commercial Hotel, Hexham, where he had been staying. It seems that Mr. Long, who is a little over sixty years of age, had been a frequent visitor to the hotel; and on the present occasion had come for a short stay. On the night of last Sunday week, he went to his room apparently in his usual health. As, however, he did not appear the following morning, and no response could be obtained by knocking, the door was forced open. The window was found closed and the blind drawn; and the room was absolutely filled with gas. The gas-tap was turned full on. Mr. Long was lying on the bed quite dead; death apparently being due to suffocation by gas. A medical man was sent for, and he gave it as his opinion that Mr. Long had been dead some hours. It is surmised that Mr. Long must have turned the gas out, and then turned it on unknowingly.

MISCELLANEOUS NEWS.

SHEFFIELD UNITED GASLIGHT COMPANY.

The Ordinary General Meeting of this Company was held last Tuesday—Sir F. T. MAPPIN, Bart., M.P., in the chair

The GENERAL MANAGER and SECRETARY (Mr. Hanbury Thomas) read the notice convening the meeting; and the report and accounts for the half year to June, which were referred to in the "JOURNAL" for the 20th ult., were presented.

The CHAIRMAN, in moving the adoption of the report, said the shareholders would notice that the capital was the same as when they met on the last occasion. They had expended on capital account during the six months £9170. This was a small amount; but owing to the high price of all kinds of material and tools that were required by the Company, they had kept the account as small as possible. The profit made during the past six months was £28,285; and they would be able to pay the usual dividend at the rate of 10 per cent. To do this, they would have to take from the balance in hand £15,639; leaving still a balance to carry forward of £14,242. The reserve fund, they would see by the accounts, was at its maximum—viz., £86,848. He ventured to say that this was not an unsatisfactory state of things, for when they raised the price of gas 4d. per 1000 cubic feet, they did not expect that this would pay the whole of the loss that they would suffer on account of the high price of coal. They had, as the shareholders knew, a large balance in hand besides the reserve fund which he had just mentioned. The result had not surprised him or his colleagues; and he did not think it had caused any disappointment to the shareholders. They had carbonized during the past six months 140,082 tons of coal, an increase of 9636 tons on the corresponding period; and the cost for coal and carriage had been £35,357 more than in the corresponding period of 1900. This sum was a large one to face; but the Company were, he thought, quite equal to the occasion, and met these difficulties quite as well as any other company in the country. They had a gratifying increase of 57,609,000 cubic feet of gas consumed; and they had received £26,884 more for gas than they did for the same period of 1900. They had also received £753 more for sulphate of ammonia. On the other side, they had received less for coke by £1847, less for tar by £1892, and less in the fitting department by £1014. Their object in the fitting department, however, was not simply to make a profit, but to know that the work they did was done efficiently. So far, with all their efforts and trouble, they had failed to arrive at the cause of the naphthalene deposits they had suffered from so long in two of their works. One of the works, as he had told them before, was practically free from naphthalene. The expenditure on coals and carriage was £35,357 more, stokers' wages £2123 more, repairs of works £3164 more, and repairs of mains £2454 more. They would have been pleased if they could have reduced this last item; but when their mains became too small, they spent money and allowed no consideration to stand in the way of supplying their customers to the best of their ability. Therefore, so far as the balance-sheet was concerned, they had had to take £15,639 from the balance in hand, and they had still a balance left of £14,242. During the half year 1117 tests of the gas had been made, averaging 17·30 candles. In the six months 48 additional gas-engines had been fixed; their capacity for work varying from ½ to 93 horse power. It surprised him very much that in a place like Sheffield, where there were so many small manufacturers, they did not use more of these engines, especially when it was borne in mind that a 2-horse power engine only cost for gas 1d. per hour to drive. Knowing this as a manufacturer himself, he was astonished that their neighbours did not go in for more gas-engines. The total amount of gas consumed by engines during the last twelve months was 177,318,000 cubic feet, being an increase of 28,680,000 cubic feet. They had fixed in the past six months 462 gas-fires and 489 boiling, grilling, and other stoves; and 5789 incandescent gas-burners had been sold. They had let out on hire 216 additional gas cooking-stoves; making altogether a total of 3038 cooking-stoves on hire. Besides these, 404 stoves had been sold. When he looked at the returns of other gas companies, he was somewhat disappointed; for he found that in Bristol at the end of last half year, they had 15,173 cooking-stoves on hire, against 3038 in Sheffield, and they had had an increase during the six months of 2078, and a further increase had occurred during the present half year. In six weeks from June 30, they had let out 576 cooking-stoves. Why Sheffield, with its much larger population, did not require more, he could not understand. He did not know whether they had noticed how well lighted South Street, Moor, was by incandescent gas-lights. It was, in his opinion, a very economical mode of lighting the streets. The four incandescent burners placed in these lamps consumed 4 cubic feet of gas per burner per hour, and gave a light equal to 350 candles, at a cost of little more than ¼d. per hour. These lamps were only about one-fifth to one-sixth of the cost of the electric arc lamps that were fixed in some large towns where they were used very much more than in Sheffield. He was very glad this was so; for the incandescent gas-burner was an excellent mode of lighting. London to-day was one of the worst-lighted capital cities in Europe, though gas was far cheaper there than in any other capital, and it was also better in quality. This must be somebody's fault; and it was no doubt that of the local authorities. If they went to the north of London Bridge, they would see the streets there as they were some forty or fifty years ago. Holborn was lighted with flat-flame burners consuming 5 cubic feet of gas per hour. Berlin was one of the best-lighted cities in Europe; and it was almost entirely illuminated with incandescent gas-lamps. This city had 27,000 of these lamps in its streets; but although in Sheffield the Moor was well lighted, altogether they had only 1190 in the town. He could not believe that they considered the flat-flame burners were up to the times. In his opinion, they should all be replaced by incandescent burners. There were 6748 of the old-fashioned lamps in the streets of the city; but the day, he believed, was not very far distant when this mode of lighting would be a thing of the past. Such superior gas lighting as they saw in the large cities of the Continent no doubt checked the progress of electric lighting. Some people complained of the trouble that the incandescent lamps gave; but the Sheffield Gas Company sent men round every fortnight to consumers' houses. The lamps were kept in proper order, and the charge for each burner was only 4d. per month. If there were more than six burners in a house, the price was only 3d. per burner. Other companies besides Sheffield had suffered in the results of their working during the past six months. The Croydon Gas Company, for instance, for the half year had to take £5556 from their reserve fund to pay a dividend of £16,285. The Glasgow Gas Department had a deficit for the year of £55,000. They raised the price twelve months ago from 2s. 2d. to 2s. 6d. per 1000 cubic feet; and to make up for the large deficit, they proposed to retain the gas at its present price of 2s. 6d. Liverpool, for the twelve months, had a deficit of £6162; and the Brighton and Hove Gas Company, a deficit of £4801. At Rochdale they had £7000 less this year than last, and had to take money from their reserve fund. The Manchester Corporation estimated they would receive from their Gas Department only £11,000, although last year they raised the price of gas 3d. per 1000 cubic feet; and the City Council had told the Gas Committee that they would not be satisfied with that, but must have during the present year £50,000 towards the rates of the borough. Therefore the Gas Committee had no other course, though they complained very much, but to raise the price another 3d. per 1000 cubic feet. So that in Manchester the price of gas was 2s. 9d. in the city and 3s. outside; whereas in Sheffield next month the price would be 2s., 1s. 10d., and 1s. 8d. The "JOURNAL OF GAS LIGHTING" for the 27th ult. said: "Why should railway companies be so dilatory in adopting the best system of lighting? Most of them have tried the incandescent gas system, but none of them to a great extent." He (the speaker) could not say why they did not try it. He had endeavoured to persuade the Midland Railway Company to use it a great deal more than they did. It was promised that the new passenger station at Sheffield would be lighted with gas; the reason given being "because it costs so much less." He held the opinion that these companies would have to be more economical in future than they had been in the past. Some of the railway companies had tried the incandescent system, and the saving at the stations mentioned where incandescent gas was used was as follows: Hampton Wick since March, 1897, had had a saving of 100,000 cubic feet per annum, which, at 2s. per 1000 cubic feet, meant £10 a year. Wimbledon Station, since June, 1900, had saved 1,750,000 cubic feet of gas, or £175 per year. At Nine Elms goods station, since March, 1901, the saving had been at the rate of 6,500,000 cubic feet per annum, and at 2s. per 1000 cubic feet, this was £650. At the Waterloo Milk Arch the saving had been at the rate of 2,250,000 cubic feet per annum, which was equivalent to £225 a year. He could not see that railway directors were doing their duty when they did not adopt the system further than they had done. An incandescent gas-burner consuming 3¾ cubic feet per hour would burn 11 hours at a cost of 1d. A light for 11 hours—a brilliant light, a light of from 50 to 60 candles—could be had for 1d. He had said something about gas lighting, and thought he had better mention one or two places that had indulged in electric light. At Kingston-on-Thames, after seven years' experience of it, there was a loss last year of £2921 to the Electric Light Department. The loss during the seven years was £8680; and in this depreciation was not taken into account. At Coventry, the deficit last year in the Electric Light Department was £2250; and no depreciation had been taken into account there. In Liverpool, the electric lighting plant, which cost a million of money, produced £6000 less last year than it did the year before. He had seen a paragraph in the papers in reference to Worksop. It said that the electric light works in that town were nearly completed, and the contractor gave a dinner, at which the chairman stated his opinion that in three or four years the electric light would do a good deal towards paying the rates. The chairman was a very courageous man to indulge in such a prognostication as that. He (the speaker) did not think that that gentleman knew much about these things, or he would not have spoken as he did. As to the cost of electric light, he saw that a party of the name of Dodd, in Poplar, a baker, had been sued for £4 2s. 6d. due to the Electric Light Department of the borough. In answer to the summons, the defendant said he was induced to sign an agreement by one of the Corporation canvassers, who stated that the light was as cheap as gas, whereas it cost him three times as much. This did not avail him much, however, for the Judge made him pay his account. In conclusion, the Chairman remarked that he had occupied a good deal of time; but he wished to emphasize one thing. If they wanted good light they must be at some little trouble and expense to have their fittings looked after properly.

The motion was seconded and carried; and the payment of a dividend for the half year of 5 per cent. on the "A," "B," and "C" stocks was then agreed to.

The proceedings concluded with the customary vote of thanks to the Chairman and Directors.

HARROW AND STANMORE GAS COMPANY.

The Half-Yearly Meeting of this Company was held on Monday last week, at the Albion Tavern, Aldersgate Street, E.C.—Mr. CHARLES HORSLEY, J.P., in the chair.

The SECRETARY and ENGINEER (Mr. J. L. Chapman) having read the notice convening the meeting,

The CHAIRMAN moved the adoption of the report and accounts submitted to the shareholders (*ante*, p. 661). He said he was very pleased to be able to tell them that on the present occasion the balance-sheet was an extremely good one—especially taking into consideration the high price of coals. It showed that the gas supply business was going on very well at Harrow, and that the electric light did not interfere with it a great deal. With the electric light in the district, the consumers wanted to burn more gas. Electricity was no doubt cleaner than gas; but when they had to pay perhaps two or three times as much for it, the difference would more than cover the cost of cleaning necessitated by the use of gas. As would be seen from the accounts, the

gas-rental for the half year ended June 30 was £8894, or an increase of £1253 over the corresponding period of the previous year. Of the additional amount received £477 was due to the increase of 3d. in the price of gas, and £776 to extra consumption. The increases in sales of gas were as follows: Harrow district, 1,100,000 cubic feet, or 5·78 per cent.; Sudbury and Harrow Weald, 426,000 cubic feet, or 9·78 per cent.; Stanmore district, 1,112,000 cubic feet, or 14·28 per cent.; and public lighting, 283,000 cubic feet, or 6·87 per cent. This made a total increase of 2,921,000 cubic feet, or 8·25 per cent. It would be seen that Stanmore still held its own. When the Company went there, they had to put down a large main; but the outlay was certainly proving remunerative. The amount received for meter and stove and fittings rental was £457, or an increase of £76. Residual products realized £1483, or a decrease of £324 when compared with the same period of last year. This decrease was chiefly due to 167 tons less coal having been carbonized, and to more coke having been taken for the carburetted water-gas plant. Water gas was now being used by nearly all the gas companies; and though at one time he did not think he would like to have it fitted up, he had now changed his mind. The total receipts for the half year were £10,878, and the expenditure £7821, leaving a profit for the six months of £3057. The increase in expenditure, compared with the corresponding period of the previous year, was £1046. Coals had cost £371 more, oil £397 more, and wages £34 more. On repairs to mains they had spent £533, which was an increase of £117. This, however, included £200 written off the suspense account—£96 for renewal of the main in Headstone Drive, and about £100 for renewal of short pieces of main and service pipes. Repairs to meters and stoves cost them £28 more, rates and taxes £45 more, lamplighters' wages £47 more, collectors and clerks £50 more, and bad debts £23 more. The workmen's insurance fund now amounted to £94; and the suspense account had been reduced to £400. As he had already mentioned, the total profit for the half year was £3057, which was a decrease of £206 on the corresponding period of the previous year. To pay the dividends recommended and loan interest, required a sum of £3017; so that a balance of £40 was left to carry forward to the previous balance, which now amounted to £1281. The quantity of coal gas manufactured during the six months was 30,374,000 cubic feet, and of oil gas 10,326,000 cubic feet—or a total of 40,700,000 cubic feet. Of this 38,188,000 cubic feet was sold, 622,000 cubic feet used on the works, and 1,890,000 cubic feet (or 4·64 per cent.) unaccounted for. He thought the percentage of leakage was very satisfactory indeed; for it would be remembered that it had been as high as 8 or 9 per cent. They had now over 1500 ordinary consumers, and more than 500 prepayment meter consumers. He considered that this was a very good report. They might have had to reduce the dividend; but instead of this they were able to announce a reduction in the price of gas by 3d. per 1000 cubic feet—the amount by which it was advanced this time last year, to meet the high cost of coal. This reduction of price did not, of course, affect the present balance-sheet, but it would the next one. The Company were doing very well; and if they continued in the same way, the shareholders would have nothing to complain of. To show how the business had progressed, he might mention that at June, 1896, after the amalgamation with Stanmore, the total receipts were £6566, and the profit £2161, as compared with a total receipt of £10,878, and a profit of £3057, in the past six months. At June, 1896, the balance carried forward after the payment of the dividend was £355; while on the present occasion it was £1281. In the former year the meter, stove, and fittings rental was £236; now it was £457.

Mr. A. H. Baynes, in seconding the motion, said he should like to refer to one paragraph in the report. They had very reluctantly lost the services of Mr. Glaisher, who for many years was Chairman of the Company. He was sure they all wished him every happiness in his closing days. He had done much for the Company, and his name would always be associated with it. Mr. A. F. Phillips had been elected a Director in his place; and he was confident this addition to the Board would prove a very valuable one.

The resolution was carried unanimously.

On the motion of the Chairman, seconded by Mr. A. F. Phillips, a dividend was declared for the half year ended June 30 last at the rate of 8 per cent. per annum on the original "A" capital, of 7 per cent. per annum on the additional "B" capital, of £5 12s. per cent. per annum on the additional "C" capital, and of 6 per cent. per annum on the guaranteed shares, all less income-tax.

On the proposition of the Chairman, seconded by Mr. Baynes, a vote of thanks was accorded to Mr. Chapman, the Auditors, and the staff generally.

Mr. Chapman, in acknowledging the vote, said that the business of the Company had, amidst strong opposition, grown very well. They had maintained the increasing rate of consumption, which seemed inclined to go forward in the future as in the past.

A similar compliment to the Chairman and Directors (on the motion of Mr. Gandon, seconded by Mr. Lennard), closed the proceedings.

METROPOLITAN GAS COMPANY OF MELBOURNE.

The Half-Yearly General Meeting of this Company was held at Melbourne, on the 26th of July—Mr. J. Grice in the chair.

The Secretary (Mr. John Hinde) having read the advertisement convening the meeting, the report and accounts for the six months ending the 30th of June were taken as read. The latter showed that the amount standing to the credit of the net revenue account was £67,053; and the Directors, after deducting £15,000, and transferring it to the reserve fund, recommended that a dividend of 4s. 6d. per share, equal to £38,574, be declared, and that the balance of £13,479 be carried forward.

The Chairman, in moving the adoption of the report, expressed the pleasure of the Directors in submitting for the shareholders' approval a balance-sheet which enabled them to recommend a dividend of 4s. 6d. per share. This was an increase of 6d. on the dividends declared for ten successive half years, which had become almost recognized as the Company's standard. There was one specially gratifying feature which largely accounted for the profits shown in the balance-sheet, and that was the lower percentage of gas unaccounted for. For several half years this amount was abnormally large, owing to the blasting operations of the Metropolitan Board of Works, which broke and cracked the mains, and caused enormous loss of gas. During the past half year, however, the percentage had been the lowest experienced for many years; being only about 8¼ per cent. of the total bulk of gas manufactured. Their Engineer (Mr. R. O. Thompson, M.Inst.C.E.) had been putting forth every effort, by continual work at the services and mains, to bring this percentage still lower. Of course, this could not be done without swelling the item of repairs, maintenance, and renewal; but money judiciously spent in this direction was received back fourfold. Another satisfactory item was the amount of £7797 received for public lighting and under contract. This showed an increase over several preceding half years, and was very gratifying, as all the contracts for street lighting were at very low rates—in fact, such as were formerly thought to be impossible. Incandescent lights were greatly in favour; and where they had been adopted for street lighting, the greatest satisfaction had been expressed, as they combined a brilliant light with a handsome appearance. With regard to a discussion which took place in the City Council a few days previously, during which it was asserted that gas lighting in the city had been replaced by electricity at a lower cost, a statement was made that one electric arc light, costing £23 per annum, had replaced four gas lights, which, under rates formerly existing, cost £25. This, however, was misleading, as the comparison, to be worth anything, should be based upon the present gas rate, which was considerably lower than the old one. He was prepared to say that the Company could light the streets of Melbourne very much better and cheaper than was being done with electricity. Having dealt with other items in the accounts, he went on to call the shareholders' attention to the fact that the employees had benefited by the Company's prosperity. Owing to an increase given to the men during the half year, the amount of wages was larger than for the corresponding period of last year. As the higher rate would be paid during the whole of the next six months, this item would appear larger when the accounts were presented in January next. The amount of the increase in wages was about £1000, and in salaries £400, for the half year. However, while congratulating the proprietors, he wished at the same time to show them the reverse side of the picture. They had not as yet felt the full effects of the increased price they were paying for coal, as during the past six months they only received coal for three months under the new and higher contract. In the current and succeeding half years they would have to bear the full brunt. He trusted, however, that the increase of business which had now been perceptible for some time, would compensate them, at any rate to some extent, for this enhanced price for coal.

Mr. E. J. White, in seconding the motion, congratulated the Directors on the satisfactory position of the Company. He said that, as the result of a recent visit he had paid to the old country, where he found gas as an illuminant was still in the ascendant, he had returned with great faith in the future of the industry. Incandescent lighting had become almost universal.

The motion was carried, the dividend recommended was declared, and the meeting closed with a vote of thanks to the Directors and officers of the Company.

AUSTRALIAN GASLIGHT COMPANY.

The Annual Meeting of this Company was held in Sydney (N.S.W.), on Monday, the 29th of July—Mr. G. J. Cohen, the Chairman of the Company, presiding.

The Secretary (Mr. R. J. Lukey) read the advertisement convening the meeting, after which the report of the Directors was taken as read. It was stated therein that the profits for the half year ending the 30th of June, after making provision for bad and doubtful debts, deducting interest on borrowed money, repairs and renewals, depreciation of plant, working expenses, and all other charges, amounted, with the balance brought forward, to £54,792. The Directors recommended the payment of a dividend for the six months of 9s. per share, free of income-tax, which would absorb £51,135; leaving a balance of £3657 to be carried forward. The Engineer (Mr. T. J. Bush, M.Inst.C.E.), reported that the Company's plant had been maintained in good condition. A disastrous fire on the 10th of July involved the destruction of the Company's show-room, and the inspector's residence, besides other losses; but the whole will be fully met by insurance. In consequence of the expansion of the Company's business, the Directors considered it advisable to raise additional capital, and they therefore decided to create 11,367 new shares of £6 each at a premium of like amount.

The Chairman, in moving the adoption of the report, referred to the outlay on extensions which had taken place since 1887, when the last call was made, which had amounted to upwards of £150,000. To carry out these works, money had to be obtained at call, at a low rate of interest. The Directors now thought the time had come when this system of carrying on the business should cease; and to place the concern on a firmer foundation, it was deemed advisable to issue the 11,307 new shares. He foreshadowed the carrying out of additions and the introduction of increased plant at Mortlake, and the laying of larger mains in various parts of the city and suburbs, which were necessary to meet the continued growing demands for gas. He also pointed out that, with the competition of the electric light now to be faced, it was highly necessary to supply gas at as cheap a rate as possible; and the interest on capital should not be too great. The Directors had recommended the issuing of 11,367 new shares at a premium of £6 each; and he felt certain the shareholders would confirm the arrangement. The new shares would be distributed in the ratio of one new to ten old shares, and holders of a less number than ten would share in the profit made on shares unallotted, as on former occasions. He further stated that the consumption of gas was increasing very satisfactorily, and but for the advance in the price of coal, the contemplated harbour dues, and other anticipated expenses, nothing could be more pleasing to the Directors. The Board had always studied the interests of the consumers as well as those of the shareholders, of which there was

evidence in the requirement of a large premium for the new shares they had recently issued.

Mr. J. MULLENS seconded the motion.

Mr. J. M. PURVES urged the Board to bring more prominently into notice the advantages of high-pressure gas supply, which was extending so rapidly in Europe. He had endeavoured to prevent the Committee of the City Council from involving the ratepayers in the expense of a much dearer lighting system until the members were acquainted with what was being done in connection with public lighting on the other side of the world. He maintained that the electric lighting of every city in the Commonwealth was inferior to the light given by the new high-pressure burners—throwing shadows, and not being so well diffused. High-pressure burners were much cheaper than electric lamps, and he trusted the Directors would push them into use.

The CHAIRMAN, in reply, said that, owing to the demand for these lights in Europe, orders which they had sent in January last had been delayed; but they expected to have the new burners shortly, and they would then be brought prominently under the notice of the public.

The report was unanimously adopted, as were also resolutions for the payment of the usual dividend of 9s. per share, and the creation of the new shares.

All the members of the Board were re-elected without opposition, as were also the two Auditors; and the Directors and officers were thanked for their efficient services to the Company.

CARLISLE CORPORATION GAS ACCOUNTS.

The Profits and the Rates.

The minutes presented by the Gas and Water Committee at the meeting of the Carlisle Town Council last Tuesday, embraced the accounts for the past year.

Mr. COULTHARD, in moving the confirmation of the minutes, said he could not congratulate the Council on the result. The high price of coal was the cause of the great decrease of the gas profits for the year, as they had paid nearly £10,000 more for coal than during the previous year, and lost £1000 by meters. But, on the whole, the accounts had come out fairly well. The loss on the year's working had been £1452. The rental from gas had increased by £617, while that from residual products had increased by £1604. This was the highest point that ever the bye-products had reached during the history of the works. For coke they obtained £6575, as against £3146 in 1890; for tar £3181, as against £1704 in 1890; for sulphate £2394, as against £1505—a total of £12,151, as against £6355, or nearly double. They would see by these figures what an important part the bye-products played in the manufacture of gas; and had it not been for this handsome sum of £12,000 odd from them, they would not have been in such a good position as they were to-day. He was glad to say that next year they might expect to benefit to the extent of some £7000 by the reduction in the price of coal; but, on the other hand, they would have to face a reduction in the price of tar to the extent of perhaps £700 or £800. They made 2106 tons of tar last year; and it had gone down in price. Coke was also falling in value. Not long ago the Committee were getting 15s. per ton, then it was reduced to 12s. 6d., and at the last meeting they made a further reduction to 10s. The money for interest and repayment on the loan of £15,000 for the new works would also have to be found; and last, but not least, they would have to pay some £1200 a year more to their employees, whose wages had been increased a month or so ago. It might interest the members to know that from the slot meters, the sum of £3800 had been realized. The increase in the number of slot meters had been 200 during the past year; and the average takings from them was about 21s. each per annum. Cookers had increased by 90 during the year. He must say he wondered that more cookers were not in use. At present only about 1000 were fixed. Turning to the subject of profits, he said the question might arise some day whether it was a wise policy on the part of the Corporation to make any profit at all on gas, because it really meant making money to reduce the rates of the city. They had to pay income-tax on this £6000 or £7000; and on this amount it meant at present £400. By using it to relieve the city or district rate, they benefited to some extent those who were not consumers of gas at all. Let him give them an illustration. At one time the Citadel Station Committee were large users of gas; their account being (say) £900 or £1000. They now had the electric light, and used little or no gas; but, all the same, if the Committee paid into the treasury (say) £7000 annually—about a third of the district rate—it went to relieve the ratepayers to the tune of about 10d. in the pound, whether they were gas consumers or not. A firm who might be paying £80 a year for gas were therefore assisting largely to relieve others from the gas profits, although they contributed nothing to such profits. And, further, he believed that if gas was reduced in price instead of making a profit, as at present, it would largely increase the demand, as had been proved whenever any reduction in price had been made; and an increase of consumption of gas would increase the bye-products, which were the backbone of every gas concern. Those were reasons why he would suggest that they should give up making a profit on gas. He had not the slightest hesitation in saying that the works would improve year by year as the city was extending in every direction, and that they would in the future, as in the past, lend a helping hand to further and develop many new undertakings which would tend to benefit and improve the city. With reference to other subjects, Mr. Coulthard mentioned that the gas stokers' wages had been increased 3d. per shift, and that in some cases there had been a reduction of 1s. per ton in the price of coal, while in others there had been an advance. He added that some time ago they advertised for tenders for meters. Eight or ten came in; but they were all the same price, and so they selected three of the best firms to supply them.

Mr. LING seconded the motion.

In the course of the discussion,

Mr. J. J. FORSTER inquired what was the difference between the coal tenders accepted in June and the present time.

Mr. COULTHARD said there had been an increase in one case.

The MAYOR said the reduction was from 6d. to 9d. a ton on the prices quoted in June.

Mr. WHITE remarked that Mr. Coulthard seemed to think it was almost a pity they made big profits sometimes, as they had to pay income-tax on the profits which they made. He did not think that Mr. Coulthard would apply this principle to his own particular business; and so far as he (Mr. White) was concerned as a member who took an active interest in the Finance Committee, he hoped the Gas Committee would go back to the old order of things, and continue to make the big profits which they had had in other years, because they found them very useful indeed in the city fund. In his opinion, there was no reason to fear that the results were likely to be less advantageous to the community in the future than they had been in past years. At no time during the last fifty years had the rates been called upon to contribute to the cost of the gas and water undertakings; and he was anxious to avert what he would look upon as a calamity. It had been their proud boast that they had not had a city rate for Corporation purposes for the last thirteen years; and it had also been their proud boast that the gas-works had always been a source of revenue to, instead of being a tax on, the community. In view of an application shortly for an extension of the city boundary, he was desirous of the Corporation being able to maintain those proud boasts, as they would be most useful items of evidence. He therefore proposed that £400 be withdrawn from the gas-works reserve, which stood at the present moment at £3550, and added to the £2561 17s. which the Gas Committee proposed to hand over to the city fund, making a total of £2961 17s., which was a sum that would meet the whole of the liabilities for instalment of principal and interest on loans; and thus they would preserve to the Corporation, and to the Gas Committee especially, the proud and independent position which they had always held of carrying on the works quite independently of the rates.

Mr. COLLIN seconded this proposition.

Mr. COULTHARD supported the proposal. It was all very well talking about the income-tax. What he had aimed at was to show that, when gas profits were made and handed over to the city fund to relieve the rates, certain individuals benefited who did not consume gas. Again, it was only a matter of taking it out of one pocket and putting it into the other.

Mr. WHITE said that, if they put it into the city fund, it could hardly be said to relieve the rates. The gas-works were the property of the ratepayers of Carlisle, and not of the gas consumers.

The minutes of the Committee were then adopted, with the addition of Mr. White's suggestion.

DEVONPORT CORPORATION AND THE GAS-WORKS.

Charges for Gas in the Naval and Military Establishments.

In a report presented to the Devonport Town Council on Thursday last, the Gas Committee explain the cause of the delay which took place in the final stages of the passage of the Corporation's Gas Bill through Parliament last session It appears that soon after the Bill reached the House of Lords, after the agreement arrived at before the Committee of the House of Commons for the transfer of the undertaking to the Corporation, the Admiralty wrote to the Corporation requiring the insertion of a provision that the Corporation should be compelled to supply gas to the naval establishments, and that the supply should be furnished at a charge 20 per cent. below the rate to ordinary consumers. Soon afterwards, the War Department wrote requesting to be placed on the same footing as the Admiralty in regard to any concession respecting the supply of gas. In the opinion of the Gas Committee, these demands were oppressive, especially having regard to a candid statement by the Admiralty that unless the terms were conceded the further progress of the Bill would be blocked. The Committee took steps to protect the interests of the Corporation in the matter, and the Admiralty carried out their threat to block the Bill. Negotiations were continued, with the result that the Admiralty agreed to take a fixed discount of 15 per cent., instead of 20 per cent. This was still unsatisfactory to the Committee, who persisted in their endeavours to protect the public interest. Eventually it was arranged that, while an initial discount of 15 per cent. was to be allowed, the Corporation should have the right to re-open the question at any time, and if no agreement were arrived at, to refer the subject to an arbitrator appointed by the Board of Trade. It was impossible to carry the matter further than this, as only a few days of the parliamentary session remained, and the Gas Committee were forced to choose between allowing the Bill to lapse altogether or taking the best terms they could obtain. Under the circumstances, they considered it satisfactory to know that the situation can be re-opened at any time. The terms agreed with the Admiralty apply also to the War Office. In each case the gas is to be supplied in bulk; and the Government establishments will have to bear the whole cost of distributing mains and loss by leakage, &c., beyond the station meters.

The report goes on to state that, by the provisions of the Act, notice to treat for the purchase of the gas-works shall be given to the Gas Company within six months after the passing of the Act. The Town Clerk has been instructed to prepare and serve the notices at the earliest opportunity. Steps have also been taken to retain Counsel and witnesses in the event of arbitration proceedings ensuing. The Committee hope that, with reasonable expedition in determining the sum to be paid to the Company, it may be found practicable to take over the gas undertaking on December 30 next. As from Aug. 17, the date of the Royal Assent to the Act, the Corporation have full power, at all reasonable times, to enter upon and inspect the lands, works, and property of the Company, and to examine their books and accounts. The Corporation are also given compulsory powers to acquire and use certain other lands for the extension of the gas-works; and in regard to these, the Town Clerk has been given instructions to serve on the interested parties notices to treat. The Committee have arranged with Mr. Sidney E. Stevenson, the present Manager, to continue with the undertaking as from the date of the transfer to the Corporation, on the same terms as those of his appointment under the Gas Company.

The action of the Committee was confirmed by the Council.

ANALYSIS OF AMMONIACAL LIQUORS.

When noticing, in the "JOURNAL" for the 16th of July (p. 162), the last report of the Chief Inspector under the Alkali, &c., Works Regulation Acts (Mr. R. Forbes Carpenter), it was mentioned that in the course of it he dealt further with the subject of the analysis of ammoniacal liquors. In the previous year's report, he described the methods of analysis then in use in his laboratory for the estimation of the sulphur present in various forms in ammoniacal liquors, and gave a statement of the conclusions arrived at with regard to the distribution of the sulphur from a comparison of the results of the analysis of liquors from various sources. His later remarks on the subject are as follows.

The estimation of the sulphur present as sulphate, sulpho-cyanide, and sulphide, was considered to be satisfactorily solved; but that of the thiosulphate was still a matter of some uncertainty, as the sum of the sulphurs present as sulphate, sulphocyanide, thiosulphate, and sulphide, in the case of liquors from gas-works rich in sulphides, was almost invariably found to be less than that of the "total sulphur" determined by bromine oxidation (the difference appearing as a *positive* percentage figure in the table of analyses); while often, in the case of coke-oven and similar liquors, where the sum of the components exceeded that of the total sulphur, the difference figure was *negative* in sign. In explanation of these "difference" figures, it was assumed that a positive figure marked the presence of polysulphide and sulphur in forms of combination other than those named above; while a negative figure was taken to be an indication of the extent to which the organic matter present had interfered with the iodine titrations.

Since the report was written, however, analyses of liquors of character somewhat different from those available at that time have rendered it necessary to modify in some respects the earlier conclusions arrived at regarding the meaning of the negative sign spoken of above, while affording complete confirmation of the correctness of the assumptions regarding the presence of polysulphide. These exceptional liquors have indicated the presence of sulphite rather than organic matter as the disturbing factor, which in the presence of mineral acids, there is reason to believe, has far less reducing action on iodine than one was previously led to suppose. As regards the presence of sulphite, it is clear that in the separation of the sulphide by zinc salt it will pass into the filtrate with the thiosulphate, and will exert there a reducing action upon the iodine used for titration. As the factor of conversion of $\frac{N}{10}$ iodine into sulphur for thiosulphate is four times as great as that for sulphite, it is evident that, unless due allowance is made for the latter, the figure for sulphur as thiosulphate will largely exceed its proper value, and a corresponding error will be introduced into the "difference" figure obtained as described above; the latter thus being made to assume a negative sign in the absence of polysulphide. (Polysulphide and sulphite cannot co-exist in the same solution.)

The estimation of sulphite in ammoniacal liquors offers extreme difficulty. The amount, in general, bears too small a proportion to the organic matter present to enable Richardson and Aykroyd's joint iodine and acidimetric method to be applied with any hope of success; and when this is the case, the presence of sulphite can only be conjectured from the appearance of a large "difference" figure of negative sign. Even when the amount of sulphite is large, the end-point of the acidimetric titration with methyl orange as indicator is by no means sharp; and the presence of organic matter during the iodine titration is always a source of danger, though it has been found possible to minimize this by the addition of 10 c.c. of $\frac{N}{5}$ hydrochloric acid before proceeding to the titration of the neutralized filtrate from the sulphide. The amount of acid so added must, of course, be allowed for in the subsequent titration with alkali.

Having, however, established the presence of sulphite beyond doubt in certain ammoniacal liquors, it became a matter of importance to determine the conditions under which it could exist in the presence of sulphide, and also how far the presence of thiosulphate in such liquors might be due to the interaction of these bodies in presence or in absence of air.

Before setting out the results of such work, however, it should be stated that later experience has failed to confirm the desirability of extracting the ammoniacal liquor with carbon bisulphide to remove organic matter before proceeding to determine the thiosulphate and sulphide, and has indicated one possible source of danger attending the use of this solvent. This danger is due to the tendency of the bisulphide to react, under certain conditions, with ammonium sulphide to form sulphocarbonate. When the method was first adopted, careful experiments on solution of ammonium sulphide failed to reveal any reduction of sulphide in the liquor from this cause; but it has been ascertained since that certain liquors—*e.g.*, shale liquors—possess the property of causing the carbon bisulphide with which they are shaken to assume a fine vesicular condition, in which state it often remains suspended in the liquor for many hours. Under these conditions, slow reaction takes place between the bisulphide and the ammonium sulphide present; resulting in the formation of sulphocarbonate, and corresponding loss of sulphide. It has, therefore, been thought desirable to abandon altogether the use of bisulphide for such a purpose. Now that the appearance of a negative sign before the "difference" figure has been satisfactorily accounted for in several cases by the presence of sulphite, less importance is attached to the removal of organic matter from liquors where the direct estimation of sulphite has proved impossible, but where its presence may reasonably be expected from the nature of the liquor and the appearance of a large "difference" figure of negative sign.

The methods of analysis described in last year's report otherwise continue the same, with the exception that since the abandonment of the method of extraction of the liquor with bisulphide, separation of the sulphide from the thiosulphate (and sulphite) is now effected by ammoniacal zinc chloride in place of neutral zinc sulphate. It should be added, also, that in the volumetric estimation of the carbonic acid the digestion at 98° C. with ammoniacal calcium chloride, necessary to decompose carbamates and complete the separation of the calcium carbonate, is now carried out in stoppered bottles kept immersed in the water-bath for 1½ to 2 hours at boiling temperature, this method being found to yield the most reliable results.

The solutions of sulphite and sulphide used in these experiments were freshly prepared for each series by passing sulphur dioxide and sulphuretted hydrogen respectively into boiled water containing sufficient ammonia or ammonium carbonate to ensure the complete saturation of the gases. Analysis of the sulphide solution showed that this method could be relied upon to give a colourless sulphide free from all products of oxidation.

The solution of polysulphide was obtained by diluting with boiled water strong ammonium sulphide solution that had become yellow by slow oxidation in contact with a limited supply of air. The amounts of sulphur as sulphide and thiosulphate in this solution were determined directly by titration with $\frac{N}{10}$ iodine. The difference between the "total sulphur" determined by bromine oxidation and the sum of that present as sulphide and thiosulphate was taken to be the sulphur present in the form of polysulphide; sulphate and sulphite both being absent.

The reactions between the various salts were all carried out in stoppered bottles of known capacity, kept at constant temperature by means of a water-bath. For experiments "in absence of air," bottles of 250 c.c. capacity were found suitable; a space of 5 c.c. being left above the liquid to allow of expansion when the temperature of the bath was raised to 115° Fahr.

At the end of the experiments, the bottles were cooled to air temperature, and an aliquot portion of the liquid removed for determination of the amounts of sulphide, thiosulphate, and sulphite present, by Richardson and Aykroyd's joint iodine and acidimetric method. Conditions were varied as regards temperature, air supply, and presence and absence of ammonium carbonate.

The following table gives the results of the experiments on the oxidation of ammonium sulphide by ammonium sulphite:—

Controlling Factor.	Volume of Air above Liquor.	Temperature.	Duration of Experiment.	Sulphite in Terms of Sulphur.	Sulphide. In Terms of Sulphur. Before Oxidation.	Sulphide. In Terms of Sulphur. After Oxidation.	Sulphide. In Terms of Sulphur. "Converted."	"Converted" per Cent. of Total Taken.
AIR ABSENT.	C.C.	°F.	Hours.	Grams.	Grams.	Grms.	Grms.	
A.—Sulphite—								
Absent	0	62	24	Absent	0·1436	0·1414	0·0022	1·5
Present, Time	0	62	24	0·1298	0·1436	0·1391	0·0045	3·1
			48	0·1298	0·1436	0·1321	0·0045	3·1
B.—Temperature—Sulphite present—								
Cold	5	70	6	0·1251	0·1469	0·1444	0·0025	1·7
Warm	5	93	4¾	0·1251	0·1469	0·1421	0·0048	3·3
Warm	5	115	4½	0·1251	0·1469	0·1405	0·0064	4·4
AIR PRESENT.								
A.—Sulphite—								
1. Absent, Time	950	62	24	Absent	0·1436	0·1240	0·0196	13·5
			48		0·1436	0·1050	0·0386	26·9
1. Present, Time	970	62	24	0·1298	0·1436	0·1208	0·0228	15·9
			48	0·1298	0·1436	0·0980	0·0456	31·8
2. Absent	950	115	2½	Absent	0·1469	0·1316	0·0153	10·5
2. Present	970	115	2½	0·1251	0·1469	0·1360	0·0109	7·5
B.—Temperature—Sulphite present—								
Cold	970	70	2½	0·1251	0·1469	0·1398	0·0071	4·9
Warm		115	2½	0·1251	0·1469	0·1360	0·0109	7·5

The following are the conclusions drawn from the experiments: (1) In the absence of air, ammonium sulphite has but little oxidizing action upon ammonium sulphite in the cold. With rise of temperature, the action is more marked, but is still inconsiderable. (2) In the presence of air, oxidation is marked; but the rate of "conversion" in a given time is very little greater than it would be if the same volume of air were allowed to act by itself. (3) Ammonium sulphite and ammonium sulphide can co-exist in the same solution.

Treating of the oxidation of gas liquor by air in stoppered bottles, the results of which are given in another table, Mr. Carpenter remarks: Analysis having constantly pointed to the presence of polysulphide in ammoniacal liquors from gas-works, it became of interest to obtain direct confirmation of this by determining whether this body was formed on the oxidation of such liquors by contact with a limited supply of air. The experiments were carried out in stoppered bottles of known capacity. Conditions were varied as regards temperature, time of contact, and relative volumes of air and liquor. The results obtained showed that the oxidation of ammonium sulphide in gas liquor proceeds on the same lines as in an aqueous solution of ammonium sulphide; polysulphide and thiosulphate being the first products of oxidation, and these bodies themselves subsequently undergoing oxidation with separation of free sulphur. The changes are hastened by rise of temperature and by increasing the volume of air relative to liquor. The following is the conclusion drawn from the experiments: That ammonium polysulphide is at once completely converted into a mixture of ammonium thiosulphate and ammonium sulphide by the action of excess of ammonium sulphite; one-half of the sulphur of the thiosulphate formed being derived from the polysulphide, the remaining half from the sulphite, in accordance with the following equation:

$$(NH_4)_2S_2 + (NH_4)_2SO_3 = (NH_4)_2S + (NH_4)_2S_2O_3.$$

Sale of Stock.—On Thursday, £10,000 of 5 per cent. stock of the Hartlepool Gas and Water Company was sold by auction at from £125 to £126 per cent.

ELECTRIC LIGHTING NOTES.

In October, 1898, the Shrewsbury Corporation applied for a loan of £33,800 for the purchase of the Shropshire Electric Lighting Company's works. Sanction was obtained for this sum except £3011, which the Local Government Board withheld pending further inquiries. Since entering into possession of the undertaking, the Corporation have made considerable additions to them, and now all the public buildings in the town are illuminated by electricity. Further extensions to the works have been found necessary, and hence an application to the Board for sanction to a further loan of £16,526. The application has been under the consideration of Mr. H. Percy Boulnois, at whose inquiry no one appeared in opposition.

It has been decided by the Devonport Corporation to restrict, for the present, the number of arc lights in the streets of the town to 16, in the principal thoroughfare. This is a remarkable curtailment of the original plan, and may or may not be significant. At present it is explained by the fact that no provision has been made in the current year's estimates for the additional expenditure. Some things have, however, occurred since the Corporation decided in August, 1900, to put up arc lamps in great numbers. For one thing, the attitude of the Corporation towards the gas undertaking has changed. As the prospective owners of the gas supply, they will no longer be under the same temptation as of old to play off the electric light against the gas to the disadvantage of both. Besides, Devonport has, in the experience of its neighbour, evidence that arc lighting is not without drawbacks, financial and otherwise.

During the two-and-a-half years that the electric lighting has been in the hands of the Leeds Corporation, the sale of current has more than doubled. Ten years ago the price of lighting was 8d. per unit, with a number of supplementary charges. Now the latter have been abolished, and the price reduced to half. A result of this has been that electric lighting is being introduced into the smaller villas and into terrace houses letting at £20 to £30 a year, as well as into small shops. The Corporation have spent £90,000 upon extensions of mains, against less than £50,000 spent by the old Company in six years. When the undertaking was acquired, the capacity of the plant installed was 4300 indicated horse power, or about 2400 kilowatts. At present there are installed or on order, engines and alternators of a total capacity of 8740 kilowatts; and when the extensions of buildings now in progress are completed, there will be accommodation for plant of an aggregate capacity of 19,940 kilowatts. It is intended to reduce the price of current used for lighting purposes to 4d. per unit at the end of the month; and a reduction will also be made in the charge for electricity used in motors.

The foundation stones of the new generating station which is now in course of erection for the Electricity Department of the Bradford Corporation in Valley Road, were formally laid last Friday by Mr. T. H. Shaw, the Chairman, and Mr. J. Akam, the Deputy-Chairman of the Electricity Committee. Addressing those present, Mr. Shaw said the work of his Committee had increased more than that of any other. In 1889 the capital expended was £18,456, while in 1900 it was £280,649. The number of consumers had risen from 43 to 1277. These figures, he thought, would show the necessity and importance of the extensions that were being carried on. Following the ceremony, luncheon was taken at the Great Northern (Victoria) Hotel. The new works will face the Midland Railway Station, and the buildings are so designed that they may be duplicated by erecting a second engine-house. The portion of the engine-room at present being built will accommodate three engines, having a total of 6000-horse power. The electric generators each have a capacity of 1000 kilos. The engine-room will be capable of containing five units of plant, with a total capacity of 10,000-horse power; and it is proposed to instal six boilers, with a capacity of 4800-horse power. The coal-store will hold 2000 tons.

The difference between promise and performance is strikingly illustrated in the case of the Plymouth municipal electricity undertaking. According to the Engineer, the first year's working was to result in a profit of £2512. As a matter of fact, it only produced £1193; and as this is not nearly enough to meet the interest and sinking fund charges, the deficiency has caused no little concern among members of the Corporation. The most unpleasant aspect of the account is that the deficiency has occurred despite the fact that the revenue has exceeded anticipations. The receipts were, in fact, £507 in excess of the estimate; but as the expenditure was £1826 more than was anticipated, there is a net difference between the actual figures and the estimate of £1319. In a rather airy way the Electricity Committee dispose of the matter by saying that coal and rates and taxes cost a good deal more than was expected, besides which there are some charges for salaries that were not included in the estimate. Alderman Radford, the Chairman of the Committee, in explaining how the difference arose, informed the Town Council yesterday week that coal had cost £679 more than was estimated; but prices had risen considerably since the estimate was prepared in 1896, while the charges for rates and taxes, which had been estimated at £150, had exceeded that sum by no less than £382. But the great difference, he said, was caused by the mistake made in calculating the cost of the buildings at the electricity works. The capital expenditure was nearly £13,000 in excess of the estimate; and there had since been further large outlay in order to meet the increased demand for current. In the new buildings, provision was made for further extensions of the plant; so that the cost of production would go down in proportion to the cost of the output. As Chairman of the Committee, added Mr. Radford, he never expected that the undertaking would pay in the first three years; but he supported it as necessary for the public lighting and the working of the tramways, and with the knowledge and belief that it would be ultimately beneficial. Mr. S. J. Page, the Chairman of the Tramways Committee, was, however, not satisfied to live wholly in the future. He pointed out that not only had the estimate of expenditure been largely exceeded, but they had an actual deficit on the first complete year's working of £1907—bringing the loss up to date to over £3000. The loss on the current year was estimated by the Electrical Engineer at £1817; so that by the end of March next they would be over £5000 to the bad as the result of two-and-a-half years' working. This was a very serious and alarming position. With a larger output, there ought to be diminished loss; but as a matter of fact the loss in the present year would be greater than it was last year. One cause of the deficit, Mr. Page went on to say, was the insufficiency of the charge for public lighting. They were told that the average cost of the current was 4¾d. per unit. Yet they were supplying the arc lamps at 1¾d. per unit. That was not just either to the tramways or the electricity undertaking. He concluded by moving an amendment to the adoption of the report, requiring the Electricity Committee to furnish an account of the estimated number of units which will be generated and sold this year, and the cost of generation for tramways, private lighting, and public lighting respectively for the past and current years. Mr. Radford, in promising to supply the information, said it would make little difference. The charge for arc lighting was equal to 1·91d. per unit, and there were towns which charged less. The only effect of reapportioning the charges would be that they would have to ask for a little more in the lighting estimates. He agreed that every Committee should bear its own costs, though after all it was a joint undertaking established for municipal purposes. With regard to the difference between the estimate and the expenditure, he was not surprised at the result, for the estimate was a "paper" estimate prepared in 1896. As the information asked for is to be furnished, the amendment was withdrawn.

THE SHEFFIELD WATER COMMITTEE'S SURPLUS.

Suggestions for Its Employment.

At the Meeting of the Sheffield City Council last Wednesday, the presentation of the minutes of the Water Committee afforded Alderman Gainsford, the Chairman, an opportunity of bringing forward suggestions for disposing of the surplus resulting from the working of the water undertaking, on which he addressed the Committee a few weeks ago (*ante*, p. 580). After considering the possibility of establishing something in the way of municipal old-age pensions, which he said he had put aside for reasons he set forth, he stated that the only other subject which had occurred to him was the practicability of improving the dwellings of the working classes. He thought this was perhaps the best disposal they could make of any surplus money they could have. It would be the best thing they could do, especially if they could improve the dwellings of the working people by encouraging and prompting the use of baths in their houses, and the extension of the water-carriage system. This, then, was the direction which he took in his suggestion to the Water Committee; and he was authorized by them to say that before long, as soon as they were able, they would bring up in detail suggestions for dealing with the surplus water revenue, principally and largely in the direction of either reducing or abolishing altogether the charges for water for baths in low-class property, and for greatly reducing or wiping away altogether those for water for water-closets also in low-class houses. The reason the Committee were unable to make a definite suggestion on the subject at the moment was that, quite unexpectedly, a legal obstacle had presented itself. But the suggestions which were made to the Committee, and which, without going too much into detail, were accepted, were simply these: That the charges for water for baths should be either abolished altogether, or very nearly so, in regard to all houses up to £20 rental; that the charge for baths in regard to houses over £20 rental should be brought under the 25 per cent. reduction, which at present did not apply to it. Also in regard to water-closets or trough closets, the charges should be either abolished or very nearly so (the reduction of 25 per cent. already applying in the case of houses above £20 rental); and that, finally, the 25 per cent. reduction should be applied to all the charges made upon the Health Committee for water, to which charges it did not already apply. This would cost the Water Department a large sum of money in two ways. One of these was the quantity of water which would be used in the increased number of baths and water-closets in the future. Of course, the object of the scheme altogether was to get a larger number of baths and closets. Therefore they had not only to take into account the reduction in the money which was received at present, but also to estimate what the reduction would be. Considering that there were over 70,000, and nearly 80,000 houses under £20 rental, it was impossible to conceive that the water-closets would come into anything like general use for a number of years to come, although there would be a continually increasing quantity of water used. However, he did not think the calculations of the Committee would be upset. The amount of immediate concession of revenue which would be involved was £5065 a year. This would be taking as large a slice of the surplus as in all probability it would be wise to take. He wished to say one word as to why the Committee proposed to draw the line at houses of £20 rental, and not extend the very large reduction to baths and water-closets in houses above £20. The reason was this: Perhaps he had better say first why the Committee did not see their way to fall in with the suggestion of Sir Charles Skelton, which was for the total abolition of all charges for baths and water-closets. Sir Charles's scheme would cost £9675 a year; and the first objection to it was that they could not afford it. This reason probably overshadowed all others; but the second was that there was no necessity to apply the reduction to better-class houses. To do so would be to give away money to rich or comparatively rich people who did not want it. A suggestion was made the other day that they were legislating for one class of the community and not for another, and that they were proposing to favour the people who lived in small houses. The reasons why a line of this sort was drawn were many. It was the low-class and not the upper-class houses which needed the improvement. What did it matter to them or to him whether or not they paid 10s. a year for a bath. And that was all it amounted to. The large sum derived from these baths and closets was made up of small items—10s. for a water-closet and 16s. for a bath; and what did it matter whether or not the richer people paid this money? There was another reason. This particular class of houses already paid less than they ought to do; and it was the low-class houses which were paying more than they ought. His suggestion did not create an injustice, but remedied one. Dealing with charges for all kinds of domestic water in Sheffield, and comparing them with the average of the eighteen largest towns in the country, he found in

every particular stage the low-class houses in Sheffield were charged above the average of the other eighteen towns. Up to a rental of £7 a year, the average was 9s. 10d. for the water-rate, and in Sheffield the charge was 15s. 2d.; up to a rental of £8, the average was 10s. 10d., and in Sheffield the charge was 16s.; up to a rental of £10, the average was 12s. 3d., and in Sheffield the charge was 18s.; and for houses with rentals of from £18 to £20, the average was £1 2s. 11d., and in Sheffield they charged £1 11s. This was the case with regard to low-class property. But when they came to houses with rents of £80 to £100, the charges were already favourable when compared with the similar charges in other towns, and no reduction was required. Houses which had a rental of £100 were charged on an average £5 9s. in other towns; and in Sheffield the charge was £5 4s. The top figure, which was for houses with rentals of £200, showed an average of £9 2s. 3d.; and in Sheffield the average was only £7. He thought, therefore, that it was only in conformity with justice that the charges should be reduced in the cases of low-class houses, and not in the case of upper-class houses. There was a legal difficulty which prevented the Water Committee from making a detailed proposal now, and it was said that the Council were not empowered to do what he had been suggesting. If this was really so, he thought it was a very extraordinary thing; and, at any rate, they hoped to devise some means to overcome the difficulty. The Town Clerk was getting Counsel's opinion on the subject. After some remarks by Sir Charles Skelton and others, Alderman Gainsford replied, and the Council passed to the next business.

THE WATER BOARD FOR SOUTHPORT, BIRKDALE, AND WEST LANCASHIRE.

With the view of bringing to a fitting termination a conference which has lately taken place between the representatives of the authorities interested in the constitution of the Joint Water Board for the above-named places, the Mayor of Southport (Dr. Isherwood) entertained the members at dinner on Monday evening last week. In the course of the after-dinner proceedings, Mr. T. Loftus, the Town Clerk of Blackpool, proposed "Success to the Southport, Birkdale, and West Lancashire Water Board." He congratulated the conference upon the success of their efforts; saying they had done what was essentially their duty by looking after a pure water supply. That such supply should be in the hands of municipal authorities was now a recognized principle. He reviewed the history of the acquisition of the Fylde Water-Works by the Joint Water Board representing Blackpool, Fleetwood, Lytham, and St. Anne's-on-the-Sea. The area on the north of the Ribble was nearly 107,000 acres; and the population to be supplied with water was about 106,000, of which the four constituent Local Authorities furnished 74,000. The Southport area was not so large—he estimated it at about 49,000 acres; but probably they would have more sources of income by reason of having more inhabited houses. The population he put at between 82,000 and 83,000, of which Birkdale and Southport furnished 62,000 or 63,000. Whatever was the result, he congratulated them upon having escaped costly litigation, which an arbitration would necessarily involve. In responding to the toast, Mr. Travis, a member of the Southport Corporation, said that in Southport they had been anxious to acquire possession of the water undertaking, so that they might act up to their motto, "The Health of the People." In 1878, when the sewerage scheme was carried out, the result was to lessen the death-rate by between 5 and 6 per 1000. The lowest year before the scheme showed a rate of 3 per 1000 higher than the highest since. The scheme cost about £200,000, and it meant the saving of the lives of 250 annually. If under the new Water Board they could get good terms, by flushing the sewers with a plentiful supply of water, he hoped they would still further decrease the death-rate. Another object Southport had in view was to keep the control of the streets in the hands of the Corporation, which they were able to do, having the gas, electricity, tramways, and water in their hands. They wanted the water-works to pay their way; but payment in money was not the only thing. He hoped the ratepayers would not be called upon to pay; but he was not so sanguine that they would do as had been done in the case of the Fylde works. He did hope, however, that the new Board would be a success; for in making the purchase they were doing something for posterity. Mr. Clinning, a member of the Birkdale District Council, also responded. He said he had no hesitation in stating that the water supply ought to be in the hands of the authorities controlling the different townships. They had a large area to cover, as Mr. Loftus had said. It was not quite so much as the Fylde Water Company had to deal with; but it was most requisite that they should have the full control over the flushing, as Mr. Travis had mentioned, for the benefit of the sewerage. With regard to the work of the conference, they had an unusual number of meetings, and they had been brought to a successful issue. Whoever might form the Board, he had no doubt their children would reap the benefit. With regard to the water, he believed they would be able to meet all contingencies, for they were told the supply was inexhaustible. In replying to the toast of "The Three Clerks," Mr. Jarrett, the Town Clerk of Southport, said he felt sure the populations of the three districts concerned had cause for congratulation at the way in which they had agreed, not only in the promotion of the Bill, but in their very careful conduct of delicate and intricate proceedings. The issue of these, he thought, was likely to be of very far-reaching importance to the populations. He recognized the assistance he had received from the other Clerks, and congratulated all concerned on the successful conduct of the Bill, and the avoidance of the expense and the almost certain irritation of lengthy, protracted arbitration proceedings, which must necessarily have been exceedingly costly.

The Blaenau Festiniog Urban District Council have called in Mr. J. C. Pennington, the Engineer to the Colwyn Bay and District Gas Company to examine and advise them as to the present condition and requirements of their gas-works.

PORTSMOUTH CORPORATION AND THE WATER-WORKS.

Abandonment of the Water Purchase Scheme.

At the Meeting of the Portsmouth Town Council last Tuesday—the MAYOR (Alderman A. L. Emanuel) in the chair—the minutes of the Water Committee, which contained a report dealing with the position of the water-works purchase question, and asking for a rescission of the resolution come to at the meeting on the 30th ult. to acquire the works (see *ante*, p. 356), came up for confirmation.

Mr. H. R. PINK (ex-Mayor and Chairman of the Committee), in moving the confirmation of the minutes, explained that, in deference to the great feeling displayed in the town against the purchase of the water-works, the Committee presented a report asking for the rescission of the resolution to purchase the Water Company's undertaking. The Committee had presented a previous report, as requested; and he felt sure that if the Committee had been allowed to go on with the purchase, in forty years' time they would have been able to hand over to their successors a most valuable undertaking. Unfortunately, ratepayers' meetings held in the town had been addressed by men who knew nothing at all about the question, but who, they must admit, possessed great sway; and people were frightened by the magnitude of the purchase. He could not shut his eyes to the fact that a great deal of the opposition arose because the Committee dared to propose compensation to the Directors; but he hoped the Council would never, as had been suggested, endeavour to buy the Company at a "knock-down" price. The Committee would console themselves with the reflection that they had done their very best; and he thought the Council could have managed the business very well. By keeping the water pure, the Water Committee would be doing good work. He trusted the Company would apply their surplus to relieving the ratepayers of the vexatious charges for closets and baths; and if they did this, the Committee would have effected some good. They had decided upon their action rather than spend £500 to bring a Bill for Parliament before a public meeting.

Mr. DUMMER seconded the motion, and complimented the ex-Mayor upon the able manner in which he had conducted the negotiations. He recognized, however, that they would not be justified in spending the large amount with a feeling that public opinion was against it. He thought that in thirty or forty years' time their action in dropping the scheme would be remembered, and perhaps criticized. He entertained no fears that there would have been any loss had they purchased, but that in years to come there would have been a profit.

Mr. A. G. CURTISS expressed his pleasure that the Committee had been wise enough to drop the matter, in deference to public opinion.

Mr. DITTMAN said the action of the Committee would be known in municipal history as the Great Surrender. So far as the articles in the newspapers were concerned, the case against the purchase was purely manufactured opinion; and he was surprised that the Committee had been frightened by the public meetings, which, he contended, were not representative of the ratepayers of the borough. He did not look upon this as a final settlement of the question, and hoped that it would be again introduced in the future.

Mr. PALIN, despite certain objections to the Committee's proposals, thought that they were going to acquire a very splendid business, at present a monopoly, at a moderate price. As a speculation, the water-works purchase was far in front of either trams or telephones; and he was sorry they had not sufficient courage to go on.

Mr. STEVENSON moved that the matter be referred back to the Committee for further consideration before a final surrender was made.

Mr. EMMETT seconded the amendment.

Mr. DUMMER asked what would be the position of the Council if the amendment were carried.

The TOWN CLERK (Mr. A. Hellard) replied that if the report was not accepted, they would have to go on.

Mr. HARMAN asked if it would not be possible to have a poll of the borough before they applied to Parliament.

Mr. PINK said it was no use having a public meeting at the present time, as it might be packed.

Dr. HANN expressed surprise that Mr. Pink had shown the white feather, as he had apparently done; and he hoped the amendment would be carried.

Mr. FOSTER thought it would have been pursuing the usual methods if the Committee had recommended the Mayor to call a public meeting to sanction the borrowing of money to promote the Purchase Bill in Parliament.

Mr. EVANS said there could be no doubt that public opinion was against the purchase of the undertaking; and he considered that the Committee had had the common sense to bow to it.

Mr. PINK, in reply, said he had no flattering opinion of the ratepayers' meetings. There were the same people at them all. The only Ratepayers' Association of any good was the one in his own ward, and they never met.

On the amendment being put, there were 8 votes in favour, and 19 against it. The original motion was then put and carried.

STOCKPORT CORPORATION FINANCES.

The Gas, Electricity, and Water Departments.

At the last Monthly Meeting of the Stockport Corporation, the abstract of accounts for the year 1900-1901, prepared by the Borough Treasurer (Mr. H. Grundy), was brought up.

Alderman LEES, in moving the adoption of the abstract, referred, among other things, to the financial position of the gas and electric light undertakings. In regard to the former, he said the gas profits for the year ending March 31, 1900, handed over to the Council during the past year, were £7531, as compared with £10,069 paid in the previous year. There was thus a decrease of £2538 in the profits applied in aid of last year's rates. This represented a decrease of 2½d. in

the pound. The Council would, he thought, appreciate that it was desirable to keep the rates as steady as possible—not increasing them one year because of the temporary diminution of profits or other income, and the next year decreasing them consequent on the reverse state of things. It therefore became very inconvenient to have great fluctuations in one of the important sources of income such as had occurred for some years past. For instance, the amount handed over to the Council in the year 1895-96 as the profits of the previous year was £16,316; in 1896-7, it was £12,015; in 1897-8, £10,300; in 1898-9, £10,300; in 1899-1900, £10,069; and, as already stated, in 1900-1, £7531. At the end of the past year, the unappropriated balance of net profits which was available for transfer to the Town Council, and would be applied in aid of the rates in the current year, amounted to £8292. The Council would, he thought, agree with him that these were such important variations that it became difficult to keep the rates at one steady figure—only increasing them when it became absolutely necessary from something more than a temporary cause. He was of opinion that they should know fairly approximately what income would be receivable from the gas undertaking in aid of the rates, and he therefore proposed to bring up for consideration by the Finance Committee, and ultimately by the Council, the propriety of either calling upon the Gas Committee to hand over a fixed sum per annum, as might be directed from time to time, or a certain percentage upon the capital. As to the electric light undertaking, the second full year's working showed a loss of £535; but with a credit balance of £119 from the previous year, and transferring the reserve fund of £217, it was reduced to £199. The Chairman of the Electricity Committee would, he believed, be able to give a very satisfactory reason for this. The accounts contained for the first time a full year's working of the Water Department since the transfer of the undertaking to the Corporation. After paying all charges, including £22,145 for interest and annuities, and repaying to the Finance Committee £511 of the £5853 expended in respect of the Water Bill of 1899, there remained a credit balance of £986. This result was very satisfactory, and had justified the estimate formed when the purchase was under consideration. As the Council were aware, the Act provided that the sinking fund instalments were not to commence till the expiration of five years after the transfer.

Alderman TURNER seconded the motion.

Mr. BURROWS said there was plenty of material for discussion, and a wonderful amount of information, in the statement which had been put before the Council, apart from the very large schemes which they had entered upon, and which were not yet ripe for fair criticism. He would, therefore, content himself with a brief retrospect of the expenditure of the borough, apart from these schemes, during the past decade. He found that in 1891 the rates were 4s. in the pound. To-day they were 5s. 5d., or an increase of 1s. 5d. in ten years; while the rateable value had increased by no less than £58,942. This no doubt showed the very material wealth and growth of the borough. There was another matter which always puzzled him, and it had reference to the gas-works. Ten years ago, the Corporation found less than half the amount they had found since in capital for the management of these works, and what was the result? The price of gas was about the same but the profits remained practically stationary, notwithstanding the large increase of capital. He was also puzzled when he came to read the report of the Gas Engineer (Mr. S. Meunier) as to the quantity of leakage. There was actually 9 per cent. leakage of gas, which went nobody knew where; and as they made billions of cubic feet, 9 per cent. of it lost was a very serious amount. Then they came to the Electricity Department. He was astounded to see in the report that 35,136 units could not be accounted for. Perhaps the Chairman of the Gas and Electricity Committee would explain these matters. Looking at the debt of the borough, it had grown out of all proportion to the development of the town, the growth of the rateable value, or the increase of its population.

Mr. MORLEY took exception to thestatement that the account of the Water Department was for the first year's working, which was up to the end of September. Comparing the first half year in the statement of accounts with the second half, he found there was a decrease, not an increase. He contended that when the sinking fund came into operation in three years' time, it would mean that the cost of the water, they proposed to get from Kinder would be 7¾d. per 1000 gallons.

Mr. T. WEBB (Chairman of the Gas and Electricity Committee) replied to the criticisms passed on his department. He said it was obvious to everyone that, under the present system, which had been in vogue so long, the profits upon the gas undertaking must vary each year. Consequently, if the Finance Committee wished to have a uniform amount handed over to them from the Gas Committee, he must have a mandate from the Council to provide so much money each year, and then his Committee would be prepared to regulate the price of gas accordingly. The Gas Committee had no "reservoir" of gas profits from which they could equalize the amount paid over each year; if they had a reserve, they might do as Alderman Lees had suggested. The speaker went on to contend that with the conditions that existed ten years ago, the Gas Committee would to-day be able to hand over from £20,000 to £25,000 a year profit upon the undertaking. He pointed out that the adoption of the eight-hour in place of the twelve-hour shift for the workmen, the reduction in the price of gas, increased wages, extra holidays, and higher rates for railway carriage, were responsible for the reduced profits. The average profit paid over was £10,111. Another factor in the reduction of the profits was that formerly they were allowed 21 cwt. to the ton of coal; now they barely got 20 cwt., which meant a loss of £500 a year. The gas undertaking had done moderately well during the past ten years; but if the Council wished for more profit, they would have to regulate the business accordingly. He went on to explain that 3 or 4 per cent. of gas was lost owing to its cooling as it passed through the pipes in the ground; while the accumulators were known to lose 15 to 20 per cent. of electricity. Explaining the loss in the Electricity Department, Mr. Webb stated that they had had an increased sinking fund and interest account to pay. They had also lost about £400 through a differential rate, which it was thought would result in increased custom. This, however, had not come.

The accounts were adopted.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 714.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME	Closing Prices.	Rise or Fall in Wk	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 12	10½	Alliance & Dublin 10 p.c.	18½—19½	..	5 7 8
100,000	10	,,	7½	Do. 7 p.c.	13—14	..	5 7 2
300,000	100	July 1	5	Australian 5 p.c. Deb. .	100—102	..	4 18 0
200,000	5	May 15	6½	Bombay, Ltd. . . .	6½—6¾	..	4 16 4
40,000	5	,,	6½	Do. New, £4 paid	4¼—4¾	..	5 9 5
380,000	Stk.	Aug. 15	12	Brentford Consolidated	262—267	+2	4 9 11
270,000	,,	,,	9	Do. New . . .	190—195	+3	4 12 4
50,000	,,	,,	5	Do. 5 p.c. Pref. .	126—130	..	3 16 11
206,250	,,	June 14	4	Do. 4 p.c. Deb. .	111—114	..	3 10 2
220,000	Stk.	Sept. 12	10	Brighton & Hove Orig.	220—225*	+3	4 8 11
246,320	,,	,,	7	Do. A. Ord. Stk. .	153—158*	+1½	4 8 7
1,047,500	Stk.	Aug. 28	5	Bristol, 5 p.c. max.	116⅝—117½	..	4 5 1
420,000	20	Mar. 28	10	British.	41½—42½	..	4 14 1
50,000	10	Aug. 15	12	Bromley, Ord. 10 p.c. .	24—26	..	4 12 4
82,850	10	,,	9	Do. 7 p.c. . . .	19—21	..	4 5 8
500,000	10	May 31	6	Buenos Ayres (New) Ltd.	9—9¼	..	6 6 4
220,000	Stk.	June 28	4	Do. 4 p.c. Deb.	94—97	..	4 2 6
150,000	20	July 17	8½	Cagliari, Ltd. . . .	22—24	..	6 17 6
100,000	10	May 31	10	Cape Town & Dis., Ltd.	15—16	..	6 5 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	52—54	..	5 11 1
550,000	Stk.	Apl. 12	12	Commercial Old Stock	270—280	..	4 5 9
236,425	,,	,,	9	Do. New do. .	205—210	..	4 5 9
238,237	,,	June 14	4½	Do. 4½ p.c. Deb.	130—135	..	3 6 8
800,000	Stk.	May 31	9	Continental Union, Ltd.	162—167	+4	5 7 9
200,000	,,	,,	7	Do. 7 p.c. Pref.	162—167	..	4 3 10
575,000	Stk.	Aug. 29	5	Crystal Palace Ord. 5 p.c.	122—127	+2	3 18 9
60,000	,,	,,	5	Do. 5 p.c. Pref.	123—128	..	3 18 2
486,090	10	July 17	10½	European, Ltd. . . .	19—20	..	5 5 0
354,060	10	,,	10½	Do. £7 10s. paid	14—15	..	5 5 0
15,079,885	Stk.	Aug. 15	4 1/16	Gas-light and Coke { 4 p.c. Ord. . .	95—97	+2	4 10 8
2,600,000	,,	,,	3½	{ 3½ p.c. max. .	88—90	..	3 17 9
3,799,735	,,	,,	4	{ 4 p.c. Con. Pref.	111—114	..	3 10 2
4,063,425	,,	June 14	3	{ 3 p.c. Con. Deb.	91—93	..	3 4 6
70,000	10	May 31	8	Hongkong & China, Ltd.	13—14	..	5 14 4
3,800,000	Stk.	May 15	10	Imperial Continental .	209—212	..	4 14 4
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.	99—101	..	3 9 4
561,000	Stk.	Aug. 29	10	Liverpool United A	231—233	..	4 5 10
718,100	,,	,,	7	Do. do. B	170—172	..	4 1 5
306,083	,,	June 28	4	Do. do. Deb. Stk.	118—120	..	3 6 8
75,000	5	June 14	4	Malta & Medn., Ltd. .	4¼—5	..	4 0 0
560,000	100	Apl. 1	5	Met. of { 5 p.c. Deb.	106—109	..	4 11 9
250,000	100	,,	4½	Melbourne { 4½ p.c. Deb.	103—105	..	4 5 9
541,920	20	May 31	3½	Monte Video, Ltd. . .	9—10	..	7 0 0
717,946	Stk.	Aug. 9	8½	Newc'tle & G'tesh'd Con.	224—226	..	3 15 3
312,855	Stk.	June 28	3½	Do. 3½ p.c. Deb.	97—99	..	3 10 8
150,000	5	May 15	8	Oriental, Ltd. . . .	7⅞—8¼	..	4 17 5
135,000	5	,,	8	Do. New, £4 10s. pd.	7—7½	..	4 16 0
15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1⅝	..	4 11 5
				*Ex. div.			

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
60,000	5	Feb. 28	7	Ottoman, Ltd. . . .	5⅞—6¼	..	5 12 0
851,070	10	Apl. 26	7	River Plate Ord. . . .	10¾—11¼	..	6 4 5
250,000	Stk.	June 28	4	Do. 4 p.c. Deb..	96—98	..	4 1 8
250,000	10	Mar. 28	8	San Paulo, Ltd.. . .	10¾—11⅛	..	6 19 1
135,000	Stk.	Mar. 14	10	Sheffield A	242—247	..	4 1 0
209,984	,,	,,	10	Do. B	242—247	..	4 1 0
523,498	,,	,,	10	Do. C	242—247	..	4 1 0
5,761,885	Stk.	Aug. 15	5	South Met., 4 p.c. Ord.	125—128	..	3 18 2
1,627,965	,,	July 17	3	Do. 3 p.c. Deb. . .	91—94	..	3 3 10
380,940	Stk.	May 15	5	Southampton Ord. . .	106—111	..	4 10 1
70,825	,,	July 17	4	Do. 4 p.c. Deb.	104—109	..	3 13 5
120,000	Stk.	Aug. 29	5½	Tottenham and Edmonton { A. 5 p.c. B. 3½ p.c.	115—120*	+2	4 11 8
250,520	,,	,,	4		85—90	+3	4 8 11
182,380	10	Jan. 16	5	Tuscan, Ltd.. . . .	8—9	..	5 11 1
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	95—100	..	5 0 0
230,000	5	Aug. 15	9	West Ham, 10 p.c. . .	5½—10½	+⅛	4 5 9
172,000	10	,,	6	Do. 7 p.c. . .	12—13	+⅛	4 12 4
140,900	Stk.	June 28	4	Do. 4 p.c. Deb.	103—108	..	3 14 1
				WATER COMPANIES.			
780,599	Stk.	June 28	11	Chelsea, Ord. . .	295—300	+5	3 13 4
150,000	,,	,,	5	Do. 5 p.c. Pref. .	150—155	..	3 4 6
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75	137—142	+1	3 3 5
175,785	,,	Mar. 28	4½	Do. 4½ p.c. Deb. .	140—145	..	3 2 1
1,720,560	Stk.	Apl. 12	7	East London, Ord.. .	188—193	+1	3 12 6
654,740	,,	June 14	4½	Do. 4½ p.c. Deb. .	143—148	..	3 0 10
980,169	,,	,,	8	Do. 3 p.c. Deb. .	95—97	+1	3 1 10
700,000	50	June 14	8	Grand Junction { 10 p.c. max..	106—109	+1	3 13 5
310,000	Stk.	Mar. 28	4	{ 4 p.c. Deb..	123—127	..	3 3 0
708,000	Stk.	Aug. 15	14	Kent	280—285	+2½	4 18 3
160,000	,,	,,	7	Do. New, 7 p.c. max..	200—205	+2	3 8 4
1,043,800	100	June 28	10½	Lambeth, 10 p.c. max..	273—278	+3	3 15 6
406,200	100	,,	8	Do. 7½ p.c. max..	207—212	..	3 15 6
350,000	Stk.	Mar. 28	4	Do. 4 p.c. Deb..	125—130	+2	3 1 7
500,000	100	Aug. 15	12 5/10	New River, New Shares	392—397	+2	3 4 6
1,000,000	Stk.	July 31	4	Do. 4 p.c. Deb..	125—130	..	3 1 7
902,300	Stk.	June 14	6	South-wark and { Ord. . . .	175—180	..	3 6 8
126,500	100	,,	6	{ 7½ p.c. max.	165—170	..	3 10 7
489,200	Stk.	,,	5	{ 5 p.c. Pref. .	147—152	..	3 5 9
1,019,585	,,	Apl. 12	4	Vauxhall { 4 p.c. A Deb.	125—130	+2	3 1 7
1,155,066	Stk.	June 14	10	West Middlesex. . .	272—277	+5	3 12 3
200,000	,,	,,	4½	Do. 4½ p.c. Deb. .	138—143	..	3 2 11
200,000	,,	Sept. 12	3	Do. 3 p.c. Deb. .	94—97*	..	3 1 10
				*Ex. div.			

NOTES FROM SCOTLAND.

From Our Own Correspondent.

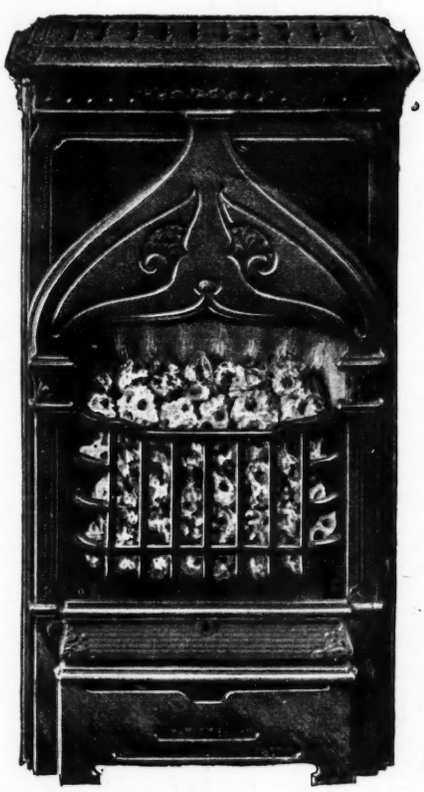
Saturday.

With the holding of the half-yearly meeting of the Waverley Association of Gas Managers at Musselburgh last Thursday, there came to an end the series of public assemblages of gas managers in Scotland for the first year of the new century. Before they meet again in conference, gas managers will have to face much hard work. Happily for them, the work in contemplation does not have the same ominous look as it did a year ago. As regards the meetings which have been held this season, there is reason for gratification at the measure of success with which they were attended. It is not yet a fortnight, as I write, since we were honoured by the important gatherings of the Incorporated Institution of Gas Engineers, in their autumn meeting, and the International Engineering Congress. These might have been expected to have withdrawn some of the attendance, as well as some of the interest, from the meetings of the more national bodies here; but neither of these effects was apparent. Probably the fact that those gatherings took place after nearly all of the Scotch meetings had been held, was the chief reason why this was so. But I think I may go a step farther, and attribute it to the sustained, if not the increasing, interest which is being taken in gas matters. The Waverley meeting was a good one, in every respect. In point of numbers it was so, and also in point of representation; for although there were, as there are on every such occasion, one or two absences which were to be regretted, the district was well represented by those who attended, and there was, in addition, a large and welcome assemblage of former members and others. It was with great regret that the members learned that their President—Mr. A. C. Young, of Kelso—would be unable to be present. The meeting lacked his bodily presence; but his mind was with them in the excellent address which he had prepared, and which, when he found he could not come himself to deliver, he sent forward. It raised a discussion which will be most valuable to gas managers who deal in small quantities of materials, and to whose works the larger questions discussed at big meetings have no application. The small works are the more numerous; and anything which benefits them, it is safe to say, is in reality the greater good for the greater number. The Association paid an official visit to the new works of the Edinburgh Corporation at Granton. The nature of these is pretty well known now; but, of course, it is one thing to read of, and quite another thing to see, a great works. The visitors on Thursday freely recognized this fact. All were delighted, and withal were greatly benefited, by what they saw, as well as by the extremely cordial reception which was accorded them by Mr. Herring. That gentleman not only received the Association at the works, but went all the way to Musselburgh to meet them; thereby devoting a full half-day of his most valuable time to the entertainment of gentlemen whom he described, in a spirit of friendliness which was quite refreshing, in the course of a few remarks at Granton, as "his neighbours."

The Lockerbie Town Council have resolved to extend the gas-works at a cost of about £1432, of which £950 is to be expended upon a new gasholder. The Contractors for the holder are Messrs. Hanna, Donald, and Wilson, of Paisley.

In February last, the Corporation of Kirkcudbright parted with the services of Mr. W. W. M'Dougall, their Gas Manager. They have since received a report by Mr. J. Wright, of Glasgow, as Auditor of the burgh accounts, which contains some melancholy reading. Mr. Wright says it appears that Mr. M'Dougall was in the habit of taking the meters, rendering accounts for gas and residuals sold, and collecting cash. It was his duty, at short intervals, to pay over the collections to the Treasurer. When he left the employment of the Commissioners, it was found that his cash-book had not been balanced, and that the ledger accounts necessary had not been opened nor posted. Ledger accounts for the year ending May 15, 1900, had not been balanced and stated so as to agree with the printed statement at that date. The Auditor was not prepared to say what sums of money, if any, had been lost to the Commissioners through the inefficiency of the Manager's book-keeping. He had adopted as correct the figures showing the cash collected by him; and on this basis the accounts produced had been prepared. The accounts showed that during the year ending May 15, 1901, there was collected or charged against consumers for sales of gas and residuals £1172, and, after deduction of £360 taken credit for in the previous revenue account, there was a net revenue of £812, as compared with £970 in the preceding year. The expenditure on coal and other stores was £699, or £278 more. Some of the items charged belonged to previous years' accounts, having been omitted therefrom. Hitherto new meters had been charged to revenue. Those might properly have been treated as capital expenditure. The Accountant, however, found that the new meters paid for in the course of the year, amounting to £37, had been purchased a considerable time ago; and it was deemed a judicious course to charge them to revenue, as in previous years. The revenue account closed with a debit balance of £467, which had arisen from the causes already mentioned. This balance had been transferred to works account, because the Auditor thought this course preferable to carrying it forward as a debit on profit and loss account for the period during which it might be expected to be extinguished by profits earned. The Auditor made recommendations as to the mode of keeping the gas accounts in future, and Provost M'Ewen said that these would be attended to.

In the adjoining town of Dumfries, there has also been trouble over the keeping of the Corporation gas accounts. Owing to errors in the stock-book—part of the system by which a late official carried on a series of peculations—two sums of £167 and £178, and a further one of £924, the amount appropriated by the official, have had to be provided for. On account of this being necessary, there was a deficit at the end of the past financial year of £675. To wipe this out, the Gas Committee recommended that the price of gas be raised from 3s. 6d. to 3s. 8d. per 1000 cubic feet. There was some discussion in the Town Council upon the recommendation; but it was carried by 16 votes to 3.



New and Artistic Designs in GAS FIRES.

"THE LAMBETH"

No. 1022.

PRICE - - £6 10s.

"THE LAMBETH" is made as an Independent Stove (as shown), or as an Interior Gas Fire for building into Tile Fireplaces.

It can also be fitted with Coloured Glass Wings to prevent side draught, 15s. extra.

R. & A. MAIN, LIMITED,

LONDON, GLASGOW, MANCHESTER, BIRMINGHAM, & BRISTOL.

An agreement has been all but completed between the Corporation of Perth and the Bridge of Earn Gas Company as to a supply of gas in bulk by the former to the latter. The basis of the agreement is that the Corporation are to charge the Company the same price as would be paid by consumers in Perth, subject to the deduction, over and above the discount of 5 per cent. allowed to consumers of 100,000 cubic feet a year, of a further discount of 5 per cent. on the total amount to be charged to the Company if 1,000,000 cubic feet of gas be taken, and other 5 per cent. if 1,050,000 cubic feet be taken. Otherwise the consumers in Bridge of Earn are to be on the same terms as consumers in Perth; and the Corporation are to provide for the upkeep and repair of the Company's pipes. The details of the agreement, which include some questions as to the Corporation being entitled to take additional lights off the main supply-pipe, have been remitted to a Committee to adjust.

The Corporation of Glasgow have written to the Town Council of Milngavie intimating that they have offered to acquire the undertaking of the Milngavie Gas Company at the price of £4000, with a guarantee that the charge for gas shall never be higher than 4s. 7d. per 1000 cubic feet. They asked the Milngavie Town Council to support them in the event of a purchase; and the reply has been sent that they are favourably considering the matter.

The Broughty Ferry Town Council do not appear to have settled down into a fixed policy with reference to the issue of gas-cookers. At this week's meeting Mr. Kidd, in terms of notice given, moved that the former basis of rent be reverted to—viz., 5 per cent. on list price. It appears that it was only recently that the Council departed from the 5 per cent. rate of depreciation, and imposed a rate of over 17 per cent. Mr. Kidd thought the new terms were a breaking of faith with their largest consumers, and that the policy was a species of financing for profit. Eventually the motion was carried by five votes to three; the Provost and another declining to vote.

That the area supplied by the Edinburgh and District Water Trust is on the verge of a water famine, is shown by a statement made by ex-Bailie Archibald, the Convener of the Works Committee, at a meeting of the Trust on Thursday. He said that if the season continued as it had begun, they would have to take steps to restrict the water supply of the community. They had already done all they could by restricting the watering of the streets as far as possible, and they had also this week, with the consent of the Local Authorities represented, instructed their inspectors to turn off the water during the night in the public conveniences. This would bring about a saving; but the city's supply of water was getting lower and lower. He was glad to say that the spring water of the North Pentlands was standing out well, yielding 4 million gallons per day. At Gladhouse, they were down pretty low—10 feet or more below the level; and they could not draw to the bottom. At Glencorse, they were not in such a good position. In 36 days, unless there was a change in the weather, both Glencorse and Loganlea would be dry, which would affect the supply of water to the city by 2½ million gallons per day. They were drawing 2 million gallons more per day than their resources could afford in ordinary seasons of rainfall; and he expressed the hope that they would not have a water famine.

The water supply to the burgh of Linlithgow failed on Tuesday last; but the Town Council were fortunately able to arrange with the Town Council of Bo'ness for a supply being drawn from their mains, at the price of 8d. per 1000 gallons. The connection was made on Thursday. The supply which has thus failed was introduced so late as 1889.

The reference, in the "Notes from Scotland" last week, to the letting of the contract for the construction and erection of the two large holders for the Provan Gas-Works of the Glasgow Corporation was not altogether accurate. The Barrowfield Iron-Works, Limited, are the fortunate contractors. In making this correction, the following particulars may be mentioned: Each holder is to be of three-lifts; and in every other respect they will correspond. The diameter of the outer lift will be 280 feet; and the lifts will have a depth of 50 feet. The capacity of each holder is fully 8¾ million cubic feet. The guide-framing will consist of 30 lattice standards 152 ft. 6 in. high, with girders, bracing, &c. The weight of materials for each holder, framing, pipes, &c., will be nearly 3000 tons; making a total of about 6000 tons in the contract placed with the Barrowfield Iron-Works.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 14.

Sulphate of Ammonia.—There has been a good demand, and further improvement in values; the closing quotations being £10 12s. 6d. per ton f.o.b. Hull, £10 15s. Leith, and £10 17s. 6d. Liverpool. There has also been considerable buying in the forward position; business being reported at £10 16s. 3d. per ton, Beckton terms, London, for October-December delivery, and at £10 17s. 6d. per ton, f.o.b. Leith, ordinary terms, for October-March delivery. At the close, business is no longer possible at these prices; makers requiring an advance of 2s. 6d. to 5s. per ton, according to position.

Nitrate of Soda has made a further advance; spot prices being 9s. 3d. per cwt. for ordinary, and 2s. 4½d. per cwt. for refined quality.

LONDON, *Sept.* 14.

Tar Products.—There appears to be a fair business doing in benzol and pitch, although the other products remain quiet. Pitch is very firm. Business has been done in Beckton at 31s. 6d. per ton, and the demand for South Wales continues very strong. Consumers are now inclined to purchase for next year, provided they can obtain their supplies on reasonable terms; but manufacturers are not particularly anxious to sell forward. The Gaslight and Coke Company ask more for forward than for prompt delivery, evidently believing in higher prices. Ninety per cent. benzol has been sold at 9½d. prompt, and 10d. October-December; the latter price being a very good one. But makers are still averse to offering for next year. In 50-90 per cent. there is no business doing.

JOSEPH AIRD
GREAT-BRIDGE,
STAFFORDSHIRE.
TUBES
AND FITTINGS
GAS, STEAM, WATER GALVANIZED-TUBES, &c.
LONDON OFFICES: 46, QUEEN VICTORIA STREET, E.C.

This article does not interest the aniline makers at present. Anthracene remains in the same stagnant state. There is really no business to report. Crude carbolic remains in the same position; but there is a slightly improved demand for prompt shipment f.o.b. London, although at outports 1s. 10d. is still the market value. Crystals continue quiet. Sales of 39-40's are reported at 7½d. per lb.; but it is not certain whether this is for English or foreign makes. Creosote is very quiet indeed, especially in the Lancashire and Yorkshire districts, where stocks appear to be rather heavy. The London prices are fairly well maintained, doubtless owing to the very large business done a little while ago for export. In solvent, business is limited to a few small transactions in specially fine qualities for home consumption. Tar remains in the same position; no contracts of any importance having recently been decided.

The average values obtaining during the week are: Tar, 14s. 6d. to 18s. Pitch, east coast, 30s. 6d. to 31s. 6d.; west coast, 28s. to 28s. 6d. Benzol, 90's, 9¼d. to 10d.; 50's, 9¼d. Toluol, 10d. Crude naphtha, 4¼d. Solvent naphtha, 11d. to 1s. Heavy naphtha, 10d. to 11d. Creosote, ⅞d. to 1⅛d. Heavy oils, 1⅞d. to 2d. Carbolic acid, 60's, 1s. 10d. Naphthalene, 60s. to 70s.; salts, 30s. to 35s. Anthracene, "A," 2¼d. to 2½d.; "B," unsaleable.

Sulphate of Ammonia.—The market is decidedly better. The Gaslight and Coke Company have raised their price to £10 17s. 6d., and even at this are not anxious to sell. One of the other large gas companies placed a considerable quantity at £10 12s. 6d., and now ask £10 15s. Business has been done at Hull at £10 10s. prompt; but for forward delivery makers ask £10 15s. A considerable business has been done in Leith at £10 12s. 6d. and £10 13s. 9d.; but makers now ask £11 for October-March. In Liverpool, business is reported at £10 13s. 9d.; and at this a fair quantity has been placed—principally, however, for prompt shipment.

COAL TRADE REPORTS.

Lancashire Coal Trade.—The steadily increasing demand for house-fire qualities since the commencement of the month, is enabling many collieries to get on to pretty nearly full time; and they are now generally disposing readily of all their output. Prices are firm at the full list basis rates of 15s. per ton at the pit for best Wigan Arley, 13s. to 13s. 6d. for Pemberton four-feet and seconds Arley, and 11s. to 11s. 6d. for common house coal. No material improvement can as yet be reported with regard to common round coals, except so far as they are in increased demand for house-fire consumption. Requirements for steam, forge, and general manufacturing purposes continue only moderate; and the lower qualities of round coal are still hanging at many of the collieries, with prices low, though perhaps not cut quite so much as they have recently been. At the pit, ordinary descriptions of steam and forge coal average about 9s. per ton; quotations much below this figure being now exceptional. Some of the better sorts are quoted up to 9s. 6d. per ton. Engine fuel, as a natural consequence of the increased demand for house-fire coal, is becoming more plentiful on the market, with prices rather easier, and very keen competition with surplus output of slack coming from other districts. Common Lancashire slack can be bought at from 5s. 6d. and 6s. per ton, good medium sorts are readily obtainable at about 7s., and best qualities only in exceptional cases are fetching more than about 7s. 6d. to 7s. 9d. Shipping is fairly active, with slightly better prices ruling; 10s. to 10s. 6d. being average figures for ordinary descriptions of steam coal, with house-fire qualities quoted from 13s. 6d. and 14s. upwards, delivered at the ports on the Mersey. A good demand is maintained for coke, with prices steadily stiffening, especially for those descriptions suitable for iron-making purposes. Lancashire furnace cokes are quoted at 14s. 6d. to 15s. per ton, good washed Yorkshire furnace cokes 14s. to 14s. 3d., and unwashed cokes 12s. to 12s. 6d., with Lancashire foundry cokes firm at 24s. to 25s. at the ovens.

Northern Coal Trade.—Though there is now a falling off in the steam coal trade, the demand for gas coals remains very high. The approach of the end of the Baltic shipments sets free much steam coal at a time when there is not any additional demand for it. Best Northumbrian steams are now lower at 12s. 9d. to 13s. per ton f.o.b., second class are 12s. to 12s. 6d., and steam smalls 5s. 6d. to 5s. 9d. But while there is a decrease in the demand for Durham coals for the Baltic, there is an increased home inquiry; so that there is not that change in price that there is in the steam coal trade. In gas coal, there are enlarged requirements from the big companies; and as the exports are still heavy, there is a full demand that takes up the output, and keeps the price for best kinds for early shipment as high as from 11s. 6d. to 12s. per ton f.o.b. For contracts over next year, however, much lower prices are taken—about 9s. to 9s. 6d. per ton being the current quotation. In coke, there is a steady inquiry, and the price is from 17s. 6d. to 18s. 6d. per ton f.o.b. for best Durham gas coke for export; blast-furnace qualities being from 15s. 9d. to 16s. per ton at the Teesside furnaces. Gas coke is rather variable; and it is probable that at some of the Teesside towns the price will be lowered soon for household purposes. For shipment, the quotation is about 12s. 6d. per ton f.o.b. in the Tyne, with a fair demand but an increasing production.

Scotch Coal Trade.—The demand for coal is improving, chiefly for export. Prices, however, remain about the same—viz.: Main 9s. to 9s. 3d. per ton f.o.b. Glasgow, ell 10s. 6d. to 11s. 6d., and splint 10s. 6d. to 10s. 9d. The shipments for the week amounted to 220,533 tons—an increase of 9222 tons on the previous week, but a decrease of 18,030 tons upon the corresponding week of last year. For the year to date, the total shipments have been 6,269,715 tons—a decrease of 1,174,894 tons upon the same period of last year.

An advance of £50 in salary has been voted, by the Pontypridd Gas Committee, to their Manager, Mr. E. Jones.

James Jordan was recently fined 2s. 6d., and 12s. 6d. costs, at the Heanor Petty Sessions, for using tin discs and other articles to obtain a supply of gas from a prepayment meter furnished by the Heanor Gas Company.

SAWER & PURVES.

(BRANCH OF METERS LIMITED),

Telegraphic Address: "SAWER, MANCHESTER."

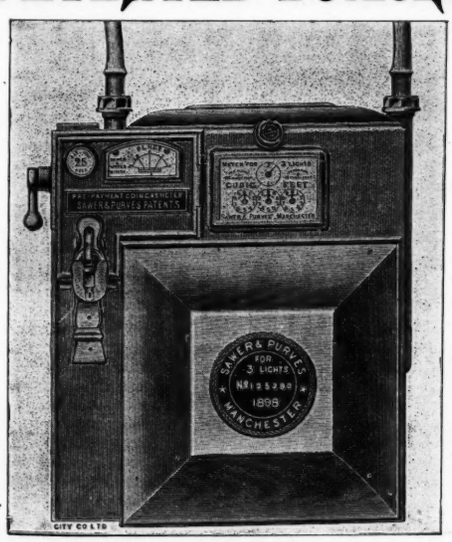
National Telephone: 3289 MANCHESTER.

NELSON METER WORKS, MILES PLATTING,

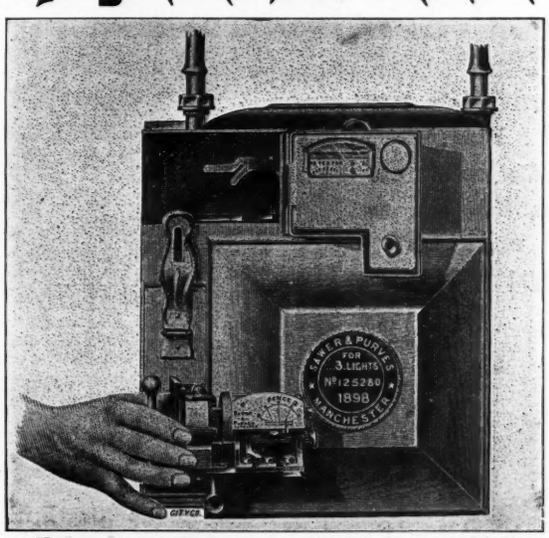
MANCHESTER.

Makers of Meters fitted with

PATENTED Detachable Prepayment Attachment.



Meter in working position.



Meter with attachment removed without uncoupling.

New Joint-Stock Company.—Under the title of the Pioneer Gas, Electric Light, and Power Company of South Africa, Limited, a Company has been registered with a capital of £2000 in £1 shares, to acquire and deal with any rights, concessions, or contracts for generating and supplying electricity, gas, incandescent, or other light, and electric, hydraulic, steam, and other power in the Cape of Good Hope, the Orange River Colony, the Transvaal, and elsewhere in South Africa, or otherwise. There is to be no initial public issue.

Cork Gas Strike.—It appears to be necessary to hold constant meetings and demonstrations in Cork to sustain interest in the cause of the gas-workers who are out on strike for frivolous reasons. A demonstration was held in their favour yesterday week. It took the form of a procession and after meeting. Alderman Cave, who was voted to the chair, claimed that every right-minded citizen must have sympathy with the honest cause of the gas workers. Sympathy, he asserted, was as marked to-day in the interests of the men who were "badly treated" as eighteen weeks ago, when the first rupture occurred. The trades would not see the men starved, so long as they (the trades) possessed a penny piece with which to aid them. After a good deal of talk of this character, the "citizens" assembled declared that they viewed with dissatisfaction the action of the Directors and shareholders of the Company in not bringing the dispute to an immediate and satisfactory settlement, and they pledged themselves to support the gas-workers on strike financially and otherwise in defence of their legitimate rights as working men. It is to be hoped the "otherwise" does not include the intimidation of workers, in the manner alleged in one of the legal paragraphs published in this issue.

Position of the Manchester Water Supply.—Meeting last Thursday, the Manchester Corporation Water Committee considered the position of the water supply. It was thought that for the present the existing restrictions are sufficient; but the Chairman and Deputy-Chairman were granted executive powers to further curtail the supply during the week if they deemed it necessary. There is an abundance of water at Thirlmere; but in the present condition of affairs, the means of conveyance are insufficient. The Committee have therefore determined to concentrate their efforts on securing as early as possible an additional pipe; but with the greatest expedition, the work cannot be concluded in less than two years. The position will be more fully understood when it is remembered that only on four occasions has the quantity of water in stock fallen below its present proportions. The worst year of all was 1868, when the water sank to 436 million gallons, as against the 1172 millions which are in hand to-day. In 1870 the quantity dwindled to 938 million gallons; in 1884, it was 929 million gallons; and in 1887 it dropped to 1135 million gallons. A dozen years ago, however, the daily consumption only amounted to about 26 million gallons per day; whereas under normal circumstances it is now about 40 millions. The original Thirlmere scheme of the Corporation provided for a daily contribution of some 50 million gallons per day, supplied by five pipes. The one pipe now available should therefore bring down a supply at the rate of 10 million gallons per day, instead of the 8 millions which reach the city daily.

Softening Stockport Water.—The Stockport Corporation have laid down an elaborate plant at their Wilmslow pumping-station for the clarifying and softening of the water. Great complaints have been heard for some years respecting the extraordinary hardness and discolouration of the water supplied in Wilmslow, Alderley Edge, and the many surrounding places. When the Stockport Water Bill was before Parliament some time ago, the Wilmslow Council took certain steps which resulted in the Corporation undertaking to provide plant for the softening of the water within two years. Operations have been going on all this year; and the Corporation will now be able to supply a soft and in every way satisfactory water in the course of a few days. The whole of the plant has been supplied by Messrs. Mather and Platt, of Salford, at a cost of £4250.

Rural Water Supplies.—District Councils are sometimes discouraged, says the "Local Government Chronicle," from undertaking works for the water supply of rural parishes by a notion that, if they once embark upon such a scheme, they will be under an obligation to convey the water to every house in the parish. It is easy to understand that such a requirement would be utterly unreasonable in many parishes, and would involve an altogether prohibitive outlay; and it is satisfactory to find that no such views are held at Whitehall. The Local Government Board have expressed the opinion that "a scheme need not necessarily make provision for the supply of water to all parts of the parish. It should provide a supply to the whole of the village, and to any other place in which there is such an aggregation of houses in proximity to wells as may render the supply from those wells liable to pollution. The rural district council are responsible for securing a supply of pure water to every house in the parish; but, in the case of isolated houses, such supply may perhaps be obtained from wells."

Water-Works for Leeds in the Burn and Laver Valleys.—Following up their inspection of the Colsterdale and Leighton reservoir sites in the territory over which they have acquired powers in the valleys of the Burn and Laver, the Water Committee of the Leeds Corporation last Tuesday visited the sites of the Carlesmoor and Leverton reservoirs. The reservoir at Carlesmoor, which will be for storage purposes, will have a capacity of 1037 million gallons. Its area will be 98 acres, and the embankment will be 620 yards in length, with a height of 101 feet. At Laverton will be a compensation reservoir. Its capacity will be 518 million gallons, its area 90 acres, and the embankment will be 550 yards long and 51 feet high. After providing for compensation water to the landowners, it is estimated that the net yield to Leeds from the Laver Valley will be 5½ million gallons per day. The water from the Carlesmoor reservoir will be passed through large mains, and be connected with other similar mains running from the intended Colsterdale reservoir and the Swinsty reservoir, in the Washburn Valley. The length of the line of easement between Colsterdale and Swinsty is about 21 miles; so that the total length of the pipe line of the old and new systems will be about 43 miles. The quantity of water which it is expected Leeds will obtain from its new source of supply is 15½ million gallons per day. It is anticipated that it will take nearly ten years to complete the works.

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

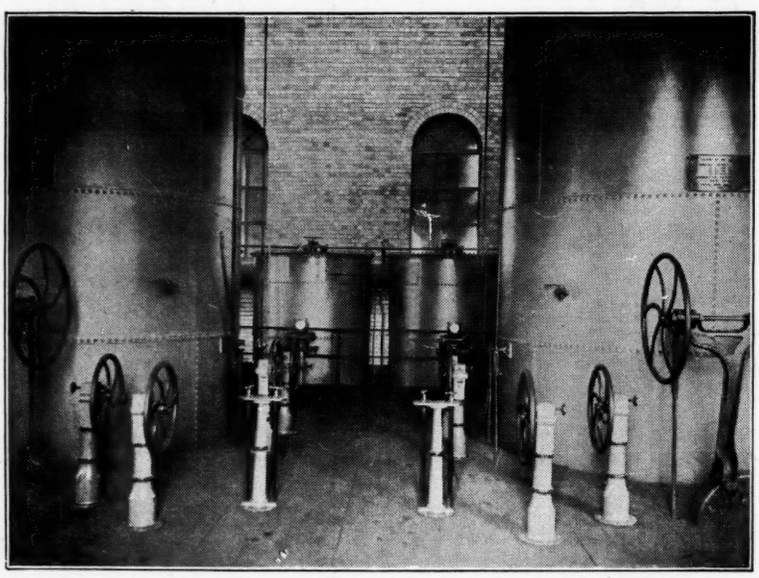
The Economical Gas Apparatus Construction Co., Ld.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. TELEGRAPHIC ADDRESS: "CARBURETTED, LONDON."

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, M.E., Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

CARBURETTED WATER-GAS ENGINEERS.

THE M.-W.-P. PLANT is designed to use the Heaviest as well as the Lightest Grade of Oil.



RESULTS PROVE EFFICIENCY.

Working Floor of Generator House. One-Fifth Section of Birmingham Plant, Windsor Street Station.

The Maximum Daily Capacity of the Birmingham Corporation's Plant, which was erected by this Company, is 12 MILLION CUBIC FEET.

Stoke Gas Undertaking.—According to the abstract of the accounts of the Stoke Corporation for the financial year ending the 31st of March last, which has just been issued by the Borough Treasurer and Accountant (Mr. T. Thompson), the borrowing powers upon the gas-works amount to £85,000, of which £81,200 has been borrowed and £12,238 repaid, leaving £68,962 owing. A sum of £82,341 had been expended on fixed plant to March 31, 1900, and £928 was spent on new meters last year. The total income of the gas-works was £24,032; and there was a gross profit of £6277, or £6374 including £97 the rent of some property. But, after paying interest and instalments of loans, this was reduced to £2654, the net profit, which was brought up to £9434 by a balance of £6780 from the previous year. Out of this sum, £3250 was paid on account of the new retort-house, and other expenditure left an undivided profit of £4904 on the gas-works, to be carried to the next account. A sum of £724 appears to have been spent on public lighting, against which there is only a charge of £100. The undivided profit of £4904 roughly represents a net profit of nearly 6 per cent. on the capital of the undertaking.

Dover Gas Company.—At the recent half-yearly general meeting of this Company, the Chairman (Mr. Willsher Mannering), in moving the adoption of the report, which has been already noticed in the "JOURNAL" (*ante*, p. 522), referred to the passing of the Bill promoted last session, whereby the Company had obtained power to raise further ordinary capital, and to modernize the spelling of their name by the substitution of an "e" for the old second "o," which was denied them when their Act of 1860 was applied for. With regard to the progress of the Company, during the first half of last year the increased sales of gas amounted to nearly 11 per cent. This had not only been maintained during the past six months, but another 3 per cent. had been added. There was considerable growth in what had become an important and profitable branch—the automatic meter supplies. During the year, 689 additional meters had been fixed. The number in use on the 30th of June was 2265, and the demand for fittings continued. The accounts showed a balance of £1593 available for distribution; but as the amount required for the full dividend was £2837, a sum of £1244 had been drawn from the reserve fund. He thought the financial result of the half-year's working might be regarded as satisfactory, considering they had had to bear the burden of the high price of coal. The motion was carried, and the usual dividend was declared. At the close of the ordinary business, a special meeting was held at which the Directors were authorized to issue ordinary stock of the nominal value of £25,000. Mr. R. Hesketh Jones proposed a vote of thanks to the Chairman, Directors, and officers, for their able management of the Company's affairs, and in so doing specially alluded to the kindly treatment the workmen received at the hands of the Directors and the Manager (Mr. R. Herring). Such good feeling between employers and employed could not, he said, but be conducive to the success of the undertaking. The proposition having been carried unanimously, the Chairman thanked Mr. Jones for his appreciative remarks, and the proceedings closed.

Halifax Gas-Works Extensions.—At this month's meeting of the Halifax Town Council, a statement of capital expenditure on account of the extensions at the south end of the gas-works was submitted, showing that up to June 30 £124,830 had been expended; leaving a margin of borrowing powers of £10,627. Councillor Collinson asked if this would be sufficient to complete the scheme. Councillor Perks said it had all gone long since. Alderman Woodhead, replying to Alderman Spencer, stated that it was estimated that another £150,000 would be required to complete the scheme. Some £40,000 or £50,000 had been spent for purposes other than those anticipated in the estimate. An opportunity would, however, be given the Council to discuss the further proposals before they were enteerd upon.

Artesian Boring at Bungay.—In view of the fact that the two recent trial borings for water in Bungay have proved unsatisfactory, owing to the water being found unfit for drinking purposes, the Town Reeve has called to his assistance Messrs. Le Grand and Sutcliff, and acting under their advice, he proposes to endeavour to get a sufficient supply of suitable quality by boring into the chalk, commencing at the bottom of the existing well at the public pump in the town. It is hoped to reach the chalk at a depth of about 130 feet; and if the supply should prove sufficient and suitable, the bore-pipe will probably be brought above the highest point at which the dug well water, which is decidedly mineral, has ever been known to rise; so that the suction portion of the pump may be placed inside the bore-pipe, with a sealed joint, and thus prevent any risk of the chalk water coming into contact with the water in the dug well.

Proposed Extension of the Meltham Gas-Works.—The members of the Meltham District Council have been exercised lately on the subject of extending their gas-works, on which they have consulted Mr. J. H. Brearley, of Longwood. On the 29th ult., the General Purposes Committee decided that Mr. Brearley should be instructed to prepare plans for the erection of a new gasholder and a retort-house for two beds of regenerator retorts, and prepare the necessary estimate, and that application be made to the Local Government Board for power to borrow money to carry out the extensions—the application to include the amount required for the purchase of gas stoves and meters. On the minutes of the Committee coming up for confirmation at the fortnightly meeting of the Council on the 2nd inst., Mr. Hirst moved, as an amendment, that they be confirmed with the exception of the portion referring to the extension of the gas-works, and that instead of this the Council should decide to purchase a gasholder at a cost of not more than £1500. Mr. Dyson seconded the amendment. After discussion, the Chairman (Mr. J. H. Preston) urged the necessity for a second holder, and appealed to the members to settle the matter at once. The amendment was put and lost; and on the original motion being submitted, it also was lost. Whereupon the Chairman announced his resignation as Chairman of the Gas Committee; saying he could not fill an office of that character when the members of the Committee and the Council held different opinions on a matter which was very important, so far as the gas-works were concerned.

CLARK'S PATENT "SYPHON" STOVES

FOR USE WITHOUT A FLUE.

NEW POWERFUL HEATER.
No. 22 "SYPHONETTE."

No Smoke! No Smell! No Dirt or Trouble! No Danger!

Consumers appreciate an Economical Heating-Stove.

The "Syphon" System is the most economical for producing Heat. There is no Waste by Flue or Chimney. The Consumption of Gas is absolutely governed by the Regulator.

WRITE FOR NEW SEASON'S CATALOGUE.

S. CLARK & CO.,
"Syphon" Works, PARK ST., ISLINGTON, LONDON, N.

Bristol Public Lighting.—The last report of the City Gas Examiner for Bristol shows that, though the main thoroughfares are illuminated by electricity, supplied from the city's own power stations, gas is still used to a preponderating extent. The past three months' consumption debited to the municipal authorities stands at no less a quantity than 43,402,511 cubic feet, which cost £4521 12s. 3d. The total number of lamps was 8027; being 5966 in the old, and 2061 in the extended area. Oil is still used for street lighting in Bristol, there being 45 lamps in which this illuminant is burnt. The bill for these for a quarter amounts to £45.

British Coal at Genoa.—According to the last report of the British Consul-General at Genoa, the imports of coal there are greater than at any other foreign port in the world. Last year they amounted to 2,455,623 tons, of which 1,375,236 tons were from South Wales and the remainder from other British ports, except 93,147 tons of coals, bricks, and coke from American ports, and insignificant quantities from those of other foreign countries. This vast trade has grown steadily since 1881, when the imports were only 617,798 tons. But while the volume of the trade is increasing, the quantity carried in British vessels decreased last year, partly, no doubt, in consequence of the higher freights earned through the war in South Africa, but partly, also, in consequence of the large purchases of British ships by Italians. In Genoa and the immediate neighbourhood, 26 British vessels were bought last year. Of these, 15 were steamers; and the aggregate tonnage was 243,371 tons. Several of the vessels were specially bought for the coal-carrying trade.

Land for Gas-Works Extensions at Chester.—Last Tuesday, Mr. H. Percy Boulnois, one of the Inspectors of the Local Government Board, held an inquiry into the application of the Chester Corporation for approval of the sale of certain corporate land adjoining the Roodee Gas-Works to the Chester United Gas Company, and of the purchase by the Town Council of other land. Mr. S. Smith (the Town Clerk) explained that last year the Company, considering it necessary to extend their works, opened negotiations with the Town Council for acquiring property adjacent to the works; and eventually a provisional agreement was entered into. Subject to the approval of the Board, and to the Company obtaining parliamentary powers of purchase, the Corporation agreed to sell 5200 yards of land at the price of £5000, and to acquire from the Company some land, comprising 1710 yards, at a cost of £1292—leaving a balance to be paid by the Company to the Corporation of £3728. Early in the negotiations the Council were not prepared to make the sale unless the Company acquired some adjoining land, and to hand over to the Council some land to add to their storage yard. By the proposed acquisition of land, the Corporation would obtain increased wharfage and store yard, which was very necessary for them. The Company had recently secured an Act of Parliament; and under the Lands Clauses Act they had compulsory powers to acquire the property in question. The Corporation, on the other hand, received land enough for widening and improving two at present narrow roads. The Inspector visited the property, and promised to report to the Board.

Bolton and its Proposed New Water Supply.—It is said that the proposal of the Bolton Corporation to obtain an augmented water supply from the ground near the head-waters of the Rivers Ribble and Hodder is arousing a good deal of opposition. The Ribble Conservators complain that the scheme would have the effect of completely destroying the value of the Ribble for trout fishing; and Blackburn has intimated that opposition will be formulated in Parliament to any application for powers to control the watershed immediately contiguous to that owned by them at Slaidburn, and which would be eventually required for Blackburn and the adjacent large populations.

The Morecambe District Council and their Gas Undertaking.—At the meeting of the Morecambe District Council on Monday last week, the resignation of the Gas Engineer and Manager (Mr. W. Duft), to which reference has been already made in the "JOURNAL," was formally accepted, and a Committee appointed to consider the question of compensation, which will have to be settled by arbitration. The Chairman (Mr. J. Brown) remarked, in reference to a request that full particulars of the negotiations which ended in the purchase of the gas-works should be furnished, that there had been neglect by their representatives in certain directions which would have to be made public. It was no use fighting shy of it.

The Gaslight and Coke Company and its Critics.—The "JOURNAL" is not alone, by any manner of means, in its criticism of the doings and defects of the Gaslight and Coke Company's management. But nothing quite so trifling has ever been criticized by any of our contemporaries as the incident mentioned in the following paragraph from the "Daily Chronicle" for Wednesday last: "The Gaslight and Coke Company is a much-abused body, and very nasty things have been said about it. But it bears them meekly and is always polite. This last quarter indeed it has been more polite than ever. Even the second demand note, which is supposed to be a little peremptory, is marked Mr. Blank, Esq.—the prefix being printed and the suffix stamped. Still, even this does not altogether reconcile one to dear gas."

Finances of the St. Helens Corporation.—The Borough Treasurer of St. Helens (Mr. John Brown) has issued his annual report and statement of the accounts of the Corporation for the past financial year. It is accompanied by remarks and the certificate of the Auditors (Messrs. Nairne and Sons). In their report, they state that the excess of assets on the gas-works account is £74,264 17s. 11d.—an increase during the year of £4208. The profits amounted to £4939. Some £2950 worth of stock was redeemed during the year; and the reserve fund was increased by £3894 12s. 10d. The capital expenditure up to date is £274,499. On the electricity account, the balance of assets is £4820—an increase of £3898; and £520 of stock was redeemed out of the revenue. The capital expenditure was £100,175 12s. 9d., and on the tramways £118,074 11s. 11d.—a total on the two accounts, which are closely allied, of £218,250 4s. 8d. On the water-works account, there is a balance of £40 on the right side. The capital expenditure has been £228,146 14s. 3d., and the excess of assets now stands at £101,838 6s. 8d.—an increase of £2474 17s. on the year.

MOST PEOPLE

Take a long time deciding what they want, but having decided, they want it at once.

. . . .

If it is a "EUREKA" they want, they can have it at once, as we always keep a large Stock of . . . . "EUREKAS" and can deliver the majority of sizes "by return."

JOHN WRIGHT & CO., Essex Works, Aston, BIRMINGHAM.

Bognor Gas Company.—To meet the requirements of the extending business of this Company, the Directors have just concluded the purchase of additional land adjacent to the works, and the fact was made a congratulatory feature at the meeting of shareholders on the 6th inst. The report presented by the Directors was eminently satisfactory. The balance-sheet for the six months ending the 30th of June showed a net balance of £1928; and a dividend for the half year of 5¼ per cent. upon the original shares, and of 3¾ per cent. upon the new shares, was recommended. The dividends would absorb £605, and leave a balance of £1323 to the credit of the profit and loss account. The quantity of gas sold during the twelve months ended June 30 was 26,729,900 cubic feet; being an increase of 2,129,900 cubic feet over the preceding twelve months. The report was adopted.

Tiverton Corporation Gas-Works.—A statement of the financial position of the gas-works for the year ended March 31 was presented to the Tiverton Town Council yesterday week by Alderman Thorne. This showed a total expenditure of £7473, and receipts £8834—leaving a profit balance of £1361. A sum of £941 was required for the sinking-fund, and £556 for interest—making a total of £1497. There was thus a net deficit of £136, which the Lighting Committee proposed to take from the reserve fund. The deficit was due to the fact that the Committee did not advance the price of gas to a sufficient extent to pay for the increased cost of coal. Alderman Thorne added that the original cost of the works was £20,000, and £2000 had been spent in extensions. They had saved £6867; and the works now stood in the books practically at £15,000. The Mayor (Mr. W. Thorne) said it was a very satisfactory statement.

Explosions of Gas.—A gas explosion took place last Tuesday at Eton College, in the red-brick lodge next to the gate leading from the Slough Road into Weston's Yard. The building is occupied by Mr. Gaffney, the Head Master's clerk, and Mrs. Gaffney; and as there was an escape of gas, Mr. R. Venner, the Manager of the Eton Gas-Works, went to the place to investigate the cause of the leakage. While he was engaged doing this, report says, with a naked light, the gas remaining in the upper room exploded, blew out several panes of glass in the window, and set the furniture on fire. The sound of the explosion brought assistance, and the flames were extinguished. Mr. Venner, who sustained slight concussion of the brain, and whose head and hands were much scorched, managed to reach his home, where he was attended by a medical man. Upwards of £50 worth of damage was recently done to the late Alderman Blake's residence, "Lebanon," Ashfield, Ross, by a gas explosion. A chandelier had been removed, and someone had accidently turned on the gas-tap. The house was in the hands of the builder for renovating, and when the workmen arrived early in the morning they found the upstairs room full of gas. Windows were thrown open, and after a time the gas seemed to have dispersed. A workman then proceeded to examine a pipe for leakages with a lighted match, and two or three loud explosions followed; gas having accumulated between the floor and the ceiling of the room below, from which it was afterwards found the escape occurred. Two men were injured, and much damage was done to the house.

Protection of Trade Union Funds.—Mr. Edmund Browne, permanent legal adviser to the Trades Union Congress, has left for the Continent to ascertain how far the funds of the Unions could be protected in the event of their being invested in foreign securities. Mr. Browne will visit the various capitals of Europe to find out what country affords the safest protection in the event of his advising the transfer of the funds and securities of the Unions from this country, in consequence of the decision of the House of Lords in the Taff Vale case.

Wentwood Water Scheme of the Newport Corporation.—At the monthly meeting of the Newport County Council last Tuesday, Mr. T. Goldsworthy submitted a report on the Wentwood water scheme. He said the Committee recommended the borrowing of £150,000 to complete the works, which had cost £272,000 odd up to the present. Good progress had been made during last month with the embankment, and the work was proceeding rapidly. Mr. Wilkinson criticized the report, and went the length of declaring incompetency and deception on the part of the Committee. Mr. Hornby denounced the fallacy trotted out again by Mr. Goldsworthy, that the scheme had cost the town nothing. If it had not been for the necessity of the Wentwood scheme, the revenue derived for many years past could have been applied to the reduction of the other rates. Mr. Canning voiced his doubts that £150,000 was enough for all purposes; and he ultimately moved an amendment that the additional sum to be borrowed should be £200,000—thus increasing the total from £406,000 to £456,000. Alderman Davis strongly advised going for the larger sum. The amendment to borrow the larger sum was lost by 22 votes to 6. A second amendment, to refer back to the Committee the amount to be asked for, was also lost; and the report was adopted.

Halesworth Water Supply.—At the monthly meeting of the Halesworth Urban Council on Monday evening last week, Mr. R. E. Haward moved the following resolution: "That, in the opinion of this Council, the time has arrived when it is desirable to provide a better water supply for the town, and that the question be referred to the Highways and Sanitary Committee to formulate a scheme and report to the Council." Mr. Haward stated that there were 157 wells in the town, the water in 52 of which was known to be altogether unfit for drinking purposes; and, in his opinion, many others would be condemned if the water from them were analyzed. Quite one-third of the houses of the town were dependent for their water supply upon the market pump. An amendment was proposed, to the effect that the wishes and opinions of the ratepayers should be first ascertained; and it was carried by 11 votes to 4, and an addition to the amended resolution was also approved. The resolution, as finally adopted, was as follows: "That, in the opinion of this Council, the time has arrived when it is desirable to provide a better water supply for the town, and that it is advisable that the wishes and opinions of the ratepayers should be first ascertained before committing ourselves to a supply by water-works; also that, prior to taking a poll, or calling a meeting of ratepayers, the Council should take steps to be in a position to give full information as to increase of rates and cost of supply to the houses."

C. & W. WALKER, LTD.,

Midland Iron-Works, Donnington, nr. Newport, Shropshire.

110, CANNON STREET, LONDON, E.C.

Telegraphic Addresses: "FORTRESS, DONNINGTON, SALOP." "FORTRESS, LONDON."
Codes used A.B.C. and "A1."
Telephone No. 12, WELLINGTON, SALOP.

GASHOLDERS
PURIFIERS

WITH OR WITHOUT STEEL STANDARDS AND TANKS.

IN CAST IRON OR STEEL.

PURIFYING-MACHINES FOR AMMONIA. SCRUBBERS.
TAR-EXTRACTORS. RETORT MOUTHPIECES OF ANY SHAPE.
Milbourne's Patent Gas Purifiers.
Milbourne's Patent Automatic Cover Fastener.

WECK'S PATENT CENTRE-VALVES.

CONDENSERS. **Cripps's Grid-Valve,** TAR-BURNERS.
Milbourne's Patent Grid-Valves,
SIEVES. **For bye-passing the lower layer in Purifiers.** VALVES.

TYSOE'S SELF-SEALING MOUTHPIECES.

Tar-Distilling Plants. **Claus' Sulphur-Recovery Plants.**

SULPHATE OF AMMONIA PLANTS.

Cork Gas Affairs.—The Town Clerk of Cork (Mr. A. M'Carthy) has received notice from the legal representative of the Cork Gas Consumers' Company that they do not intend to proceed with the action instituted by them to recover £3000 odd in respect of the alleged malicious destruction of a gasholder, the circumstances connected with which will be fresh in the memory of readers. At the meeting of the Council a few days since, this notice of motion by Mr. Lane was on the paper: "That the penalties which the Act of Parliament prescribes on the default of the Gas Company to supply gas at the pressure and illumination power therein stated be enforced against the Company, the same to take effect from the time the gas supplied fell short of the proper standard." When the motion was reached, the Town Clerk said he had received a copy of the Company's Act within the past few days; and he found that the Corporation were bound to appoint a competent person as tester, that the test should be made at the offices of the Company, and that the competent person is bound to give notice to the Company of his intention to test. Until these things were done, no prosecution could take place. He might say that up to the strike, the question of appointing a competent person never came before the Council; and, in fact, the Gas Company till that date supplied gas above the standard. Alderman O'Connor moved that immediate measures be taken to appoint a competent person to do the work. He was sure the members would agree with him that it was most painful to have recourse to any steps that would do injury to any member of the Company; but the citizens should be protected, and should get proper of gas. After a brief discussion, the motion was passed; and the City Analyst was appointed to the position.

At the last monthly meeting of the Middleton Town Council, it was resolved that 25 cubic feet of gas should be supplied for 1d., instead of 21 cubic feet as at present.

The Directors of the Ilford Gas Company report an increase of 18 per cent. in the quantity of gas sold during the half year to June 30, compared with the corresponding period last year.

The Davis Gas-Stove Company, Limited, intimate that warrants were posted to the shareholders on the 10th inst., for a dividend at the rate of 8 per cent. per annum, for the six months ending June 30.

At a gas cookery exhibition lately, an old farmer entered, who, having listened to the merits of gas cooking-stoves, ordered and paid for a cooker, which was duly sent to his home, in a country village. About three months after, he called on the manager of the gas-works, and complained that the cooker was a fraud—that he had tried everything, and nothing would cook in the "bloomin' thing." The manager asked if anything was wrong with his gas; to which he replied, "Gas! What's gas?"

The advantages derivable from cooking by gas, especially when using a Main cooker, are set forth in a light readable article, by "Ethel," in the "Montrose Standard" of the 6th inst. The writer throws out a suggestion that the local Gas Company would be well advised to supply gas for heating purposes on the same principle as they supply it for gas-engines—viz., by separate meter and at a cheaper rate. She thinks this might be the means of popularizing cookers and gas-stoves generally. The suggestion will apply in other places than the one specially indicated.

The New Conveyor Company, Limited, of Smethwick, have been very successful in securing some of the recent contracts for new plant. In their hands have been placed contracts for installations of coke conveyors for the gas-works at Leicester, Cradley, and Swansea. The Company's tender for a large installation of inclined retorts—including the furnace work, retort-settings and fittings, all ironwork, shot-pouch charging system, and conveying plant—has been accepted by the Swansea Gaslight Company. Their tenders have also been accepted for all the structural ironwork, continuous steel hoppers, and conveying plant required in connection with gas producer plants at Glasgow, Manchester, and Mond gas plant at Warrington. Contracts for coal and ash conveying plants for the Birmingham and Newport (Mon.) Corporations electricity works have likewise been confided to them.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

TERMS OF SUBSCRIPTION to the "JOURNAL."

One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.

Payable in Advance. If credit is taken, the charge is 25s. a year.

Telegraphic Address: "GASKING, LONDON."
Telephone Number: Holborn 121.

All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale than all other Oxides combined. Purity and uniformity of quality guaranteed.

JOHN WM. O'NEILL, Managing Director,
160, 161, & 162, PALMERSTON BUILDINGS,
OLD BROAD STREET,
LONDON, E.C.

ANDREW STEPHENSON, AGENT. All communications re Oxide to the Company as above.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.

Resists 4500° Fahr. Best for use in GAS-WORKS.

ANDREW STEPHENSON,
182, Palmerston Buildings,
Old Broad Street,
"Volcanism, London." London, E.C.

BROTHERTON & CO.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

PENNY-IN-THE-SLOT WORK.

H. GREENE & SONS, Ltd., are prepared to give QUOTATIONS to Gas Companies or Corporations for FITTING UP COMPLETE and CARRYING OUT the WORK in its entirety, either in Iron or Compo.

19, FARRINGDON ROAD, LONDON, E.C.
Telegrams: "LUMINOSITY."

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

For all Joints in connection with Oil Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

GAS TAR wanted.

BROTHERTON AND Co., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHATE OF AMMONIA

SATURATORS and LEAD WORK for Sulphate of Ammonia Plants.

For REPAIRS or ALTERATIONS, ring up "0848 BOLTON," or Telegraph "SATURATORS, BOLTON."

Largest Practice and most Up-to-Date Works in Britain.

JOSEPH TAYLOR AND Co., CENTRAL PLUMBING WORKS, BOLTON.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM; and 45 & 47, Westminster Bridge Road, LONDON, S.E.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

AMMONIACAL LIQUOR wanted.

BROTHERTON AND Co., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

TO GAS AND WATER OFFICIALS.

HIGH-CLASS CYCLES at Reasonable and LOW PRICES. Guaranteed and sent on approval. For Cash or Gradual Payments. Catalogue post free. Old Machines Exchanged or Repaired.
MELROSE CYCLE COMPANY, COVENTRY.

SULPHURIC ACID for Sale.

BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.

Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

SADLER & CO., Ltd., Middlesbrough, Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

PATENTS FOR INVENTIONS.

Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.

Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

PREPAYMENT METER WORK.

CONTRACTS are undertaken by William EDGAR for FITTING UP HOUSES, complete with the PENNY-IN-THE-SLOT INSTALLATIONS. Gas Companies or Corporations indemnified against loss through Accidents, &c. Thousands of Houses have been fitted up by me under this System. Estimates free.

BLENHEIM HOUSE, 23, Lower Mall, HAMMERSMITH.
Telegrams: "Gasoso."
Telephone No. 14 Hammersmith.

OXIDE OF IRON OF FINEST QUALITY.

BALE'S Special Fire Cement should be used to keep Retorts, Furnaces, &c., in good repair during the heavy Winter Work.

Send for full Particulars to
BALE & Co., 120 & 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."
Telephone "277 HOLBORN."

WANTED, by Advertiser (age 24, married), a Situation as BLACKSMITH. Employed three-and-a-half Years at the Gas-Works, Margate. First-Class References.

Address No. 3745, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, Employment as Inspector of Meters, Mains, and Gas-Fitters' work. Well up in Incandescent Lighting, Gas-Cookers, and Heating Stoves. Willing to make himself generally useful on a Gas-Works or in the Workshops. Has had large experience.

Address No. 3739, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Practical Man, a Situation as MANAGER of Gas-Works, making 5 to 12 Millions per annum. Has had a lifetime experience, with Generator and Regenerative Settings, Gas Fitting, Main and Service Laying, Fixing Cooking-Stoves and Slot Meters, and the General Routine of Gas-Works. Is at present Sole Manager of Works, making 3 Millions. Age 35 years. Total Abstainer. Highest References.

Address, stating Salary and Particulars, No. 3746, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Manager for Tar and Sulphate of Ammonia Works.

Apply, by letter, stating Salary and Qualifications, to No. 3744, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

RETORT Setter and General Bricklayer required. Constant Employment to experienced and steady Man.

Apply, stating Wages required, with *copies* of Three Testimonials, to the ENGINEER, Gas-Works, Gravesend, KENT.

WANTED, as soon as possible, a MANAGER'S ASSISTANT, with practical knowledge of Engineering, for Coal Distillation Works.

Write, giving full Particulars, regarding former Employment, Salary required, and time of entering position, to Z.O. 190, Deacon's Advertising Offices, Leadenhall Street, LONDON.

WANTED, by a Gas Company, 30 miles South of London, a competent GAS-FITTER. Must be well up in Incandescent Work and Iron and Compo., and used to Prepayment Fittings. None but steady, reliable Men need apply. Permanent Employment.

Address No. 3743, care of Mr. King, 11, Bolt Court FLEET STREET, E.C.

DRAUGHTSMAN wanted. One with Experience in Elevating and Conveying Machinery, Structural Work, and Gearing.
Apply, stating Age, Wage, and Experience, to GRAHAM, MORTON, & Co., Engineers, LEEDS.

RETORT Setter and General Bricklayer wanted at a medium sized works within 30 miles of Birmingham; a young man with a good knowledge of Winstanley's and Klönne settings.
State Age, previous Employment, Wage required, and enclosing *copies* only of Testimonials, to No. 3740, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-WORKS FOREMAN.

WANTED, experienced and thoroughly competent FOREMAN for Provincial Gas-Works. Good opening for suitable Man, who must be well up in modern methods of Manufacture and the Use of Machinery, active, and competent in the control of Men.
For Particulars, apply, by letter, to No. 3742, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C., stating Age, Wages expected, &c. Applications treated as strictly private.

URBAN DISTRICT COUNCIL OF PADIHAM.

THE Urban District Council of Padiham require an ENGINEER and MANAGER for their Gas-Works, Inskip Street, Padiham.
The present make of Gas is 55 million cubic feet per annum.
Salary, £130 per annum.
Applications, with recent Testimonials (Three only), endorsed "Engineer and Manager," to be sent to the undersigned on or before Tuesday, Oct. 1 next, and addressed to the Chairman of the Gas Committee.
J. R. SMITH, Clerk.
Council Chambers, Padiham,
Sept. 5, 1901.

SHEFFIELD UNITED GASLIGHT COMPANY.

THE Directors of this Company require a SUPERINTENDENT for their Grimesthorpe Gas and Chemical Works.
The present maximum make of Gas is 5 million cubic feet per day; Sulphate of Ammonia, about 3000 Tons per annum; and Sulphuric Acid, about 2500 Tons per annum.
Salary £300 per annum, with House, rent free.
Applications, marked "Superintendent," stating Age and Previous Engagements, to be made by letter only, addressed to the undersigned, not later than Friday, September 20, 1901.
Testimonials not to be sent till asked for.
HANBURY THOMAS, General Manager and Secretary.
Gas Offices, Commercial Street,
Sheffield, Aug. 30, 1901.

FOR SALE—Good second-hand Round STATION METER, 3000 cubic feet per hour, 6-inch Connections, and Bye-Pass.
Apply GAS COMPANY, LARGS.

FOR SALE—One Station Meter, com- plete with Fittings, and One GOVERNOR, with Inlet and Outlet, both by J. & J. Braddock. One WALKER CENTRE-VALVE, with 6-inch Connections.
For further Particulars, apply to WILLIAMS, CORNFORTH, AND Co., Kidsgrove, STOKE-ON-TRENT.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY Gas Engineer, Thornhill, DEWSBURY.

TO BE SOLD—
GASHOLDER (with Wrought-Iron Tank), 30 ft. by 12 ft. Cable Guided. New in 1895.
CENTRE-VALVE, 15 in. diameter, by Walker, for Four Purifiers.
Four PURIFIERS, 10 feet square, in line, with Planed Joints, Walker Centre-Valve, Covers, and Traversing Crab Lifting Gear. Will be refixed equal to new.
Write J. WRIGHT, Bridge House, BLACKFRIARS, E.C.

FARNWORTH AND KEARSLEY GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of this Company invite TENDERS for the Supply of COAL and CANNEL for delivery between October, 1901, and the 31st of July, 1902.
Forms of Tender and Specification can be had from the undersigned.
Sealed Tenders to be addressed to the Chairman, J. W. Watkinson, Esq., and to be delivered on or before the 25th day of September.
THOS. LEA SHEPPARD, Manager.
Gas Offices, Farnworth,
Sept. 6, 1901.

BOROUGH OF LEIGH.
(GAS DEPARTMENT.)

THE Gas and Water Committee of the above Corporation invite TENDERS for the surplus TAR for the year ending September 30, 1902. Approximate quantity, 900 tons.
Forms of Tender, and any further Particulars, may be obtained from the Manager, Mr. J. Foster, Gas-Works, Leigh, Lancs.
Sealed Tenders, endorsed "Tender for Tar," to be sent to me the undersigned not later than twelve o'clock noon on Saturday, the 21st day of September, 1901.
By order,
PEREGRINE THOMAS, Town Clerk.
Town Hall, Leigh, Lancs.,
Sept. 6, 1901.

FOR SALE.

THE Ipswich Gaslight Company have FOR SALE two Armstrong's HYDRAULIC CRANES, with Pumping-Engine.
These Cranes are in good working order, and have been constantly in use for unloading Coals into the Company's works, but are now being displaced by larger Cranes.
Further Particulars may be had on application to the SECRETARY, Carr Street, IPSWICH. Inquiries invited.

THE Cowes Urban District Council in- vite TENDERS for the supply and erection of a FOUL MAIN and Tar Outlet, including 100 feet run of 18-inch Wrought-Iron and 110 feet of 4-inch Cast-Iron Pipe, Connections, &c.
Particulars from N. H. Humphrys, Gas Engineer, Salisbury.
Tenders to be addressed to the Secretary, Mr. WILLIAM HALLIDAY, 40, High Street, Cowes, ISLE OF WIGHT.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply and Erection of STEEL GIRDERS and COAL HOPPERS at their Albion Street Works.
The Drawings may be seen, and copies of the Specification, and Form of Tender obtained, on application to Mr. Wm. W. Woodward, Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Girders, &c.," addressed to the Chairman of the Gas Committee, Town Hall, Salford, to be delivered to me not later than Three p.m. on Thursday, the 3rd of October, 1901.
L. C. EVANS, Town Clerk.
Town Hall, Salford.

WINSFORD URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the surplus TAR and AMMONIACAL LIQUOR which may be produced at their Works during the Year from the 1st day of October, 1901, to the 30th day of September, 1902. To be delivered free on Rail at the Cheshire Lines Station, Winsford, in Contractors' small Tanks. The estimated quantity of Tar is 10 Tons, and Liquor 100 Tons.
Any further Information required may be obtained from the Manager, Mr. F. Sidwell.
Tenders to be delivered to the undersigned not later than Nine a.m. on the 25th day of September, 1901.
Dated this 6th day of September, 1901.
JNO. H. COOKE, Clerk to the Council.
Council Offices, Winsford,
Cheshire.

WALLASEY URBAN DISTRICT COUNCIL GAS-WORKS.

TO TAR DISTILLERS AND OTHERS.

THE Wallasey Urban District Council are prepared to receive TENDERS for the purchase of the surplus GAS TAR (about 2000 Tons per annum), produced from time to time at their Gas-Works, Great Float, near Birkenhead, during a period of One or more Years from the 30th inst.
A Pipe is laid between the Gas-Works and the Great Float for the conveyance of the Tar into the Contractor's Boats, or the Council will, if necessary, provide Appliances on their own Siding to Pump the Product direct into the Contractor's Railway Tank-Waggons.
Any further Information may be obtained on application to the Engineer, Mr. J. H. Crowther, at his Office at the Gas-Works.
Sealed Tenders, endorsed "Tender for Tar," and addressed to the undersigned, to be delivered at my Office, per post, as below, not later than the morning of Thursday, the 19th inst.
The Contractor will be required to enter into a Bond, with approved Sureties, for the due performance of the Contract.
The Council do not bind themselves to accept the highest or any Tender.
By order,
H. W. COOK, Clerk to the Council.
Public Offices, Church Street,
Egremont, Cheshire, Sept. 9, 1901.

COMMERCIAL GAS COMPANY.

THE Directors of the Commercial Gas Company are prepared to receive TENDERS for the surplus BREEZE produced at their several Works, for the Twelve Months ending the 30th of September, 1902.
The quantities are estimated to be as under, but the same cannot be guaranteed, and may be more or less:—
At the Stepney Works on the Regent's Canal—
1000 chaldrons (of 48 bushels) of Fine Coke Breeze, and
1000 chaldrons (of 48 bushels) of Rough Pan Breeze.
At the Wapping Works, on the River Thames—
2200 chaldrons (of 48 bushels) of Fine Coke Breeze, and
2200 chaldrons (of 48 bushels) of Rough Pan Breeze.
At the Poplar Works, in Bow Creek (free waterway)—
4000 chaldrons (of 48 bushels) of Fine Coke Breeze, and
6000 chaldrons (of 48 bushels) of Rough Pan Breeze.
The Tenders may be for the whole or for one or more Works separately.
The Contractors must give security to remove the Breeze as it accumulates, to pay for the same monthly, and generally for the due fulfilment of the contract.
The Form of Agreement to be signed can be seen at the Company's Offices.
Tenders, sealed and endorsed "Tender for Breeze," to be delivered here not later than the 19th inst.
The Directors reserve to themselves the right to accept any Tender in part or in whole, and do not bind themselves to accept the highest or any Tender,
Commercial Gas-Works,
Stepney, E., Sept. 10, 1901.

RHONDDA URBAN DISTRICT COUNCIL.
(GAS AND WATER DEPARTMENT.)

THE above Council are prepared to receive TENDERS for the supply of IRONMONGERY, LEAD PIPE, WROUGHT-IRON TUBES, GUN-METAL FITTINGS, GAS AND WATER FITTINGS, OIL, &c., as may be required for the Half-Year ending the 31st of March, 1902.
Further Particulars and Forms of Tender may be obtained on application to the Engineer and Manager, Mr. Octavius Thomas, Gas and Water Offices, Penrhe R.S.O., Glam.
No Form of Tender other than that issued by the Council will be accepted.
The Contractors will be required to pay the Standard Rate of Wages recognized in the District.
Tenders, endorsed "Contract No. 1, 2," &c., as the case may be, addressed to the Chairman of the Gas and Water Committee, to be sent to the undersigned on or before Ten a.m. on Thursday, the 26th inst.
The Council do not bind themselves to accept the lowest or any Tender.
W. P. NICHOLAS, Clerk.
Council Offices, Pentre R.S.O.,
Glam., Sept. 12, 1901.

COMMERCIAL GAS COMPANY.

NOTICE is Hereby Given, that an ORDINARY MEETING of the Commercial Gas Company will be holden at the Cannon Street Hotel, in the City of London, on Thursday, the 3rd of October, 1901, at Twelve o'clock at noon, to receive the Report of the Directors, and to declare a Dividend.
The STOCK TRANSFER BOOKS WILL BE CLOSED from the 20th of September inst. to the 3rd of October next, both days inclusive.
By order of the Board,
H. D. ELLIS, Secretary.
Offices: Stepney,
Sept. 11, 1901.

BRITISH GASLIGHT COMPANY, LIMITED.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of this Company will be held at this Office on Wednesday, the 25th inst., at Twelve o'clock precisely, to transact the usual Business, to declare a Dividend for the Half Year ended the 30th of June last, to elect Two Directors in the place of those who go out by rotation, and to appoint Two Auditors. The retiring Directors and the present Auditors are eligible for re-election.
Notice is Hereby also Given, that the TRANSFER BOOKS of the Company WILL BE CLOSED on the 14th and RE-OPENED on the 26th inst.
By order of the Court of Directors,
H. B. CHAMBERLAIN, Secretary.
Chief Office: No. 11, George Yard,
Lombard Street, London, E.C.,
Sept. 4, 1901.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.
He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.
Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

CRESSWELLS' ASBESTOS CO., LTD.
WELLINGTON MILLS
BRADFORD, YORKS.
Asbestos Spinners and Manufacturers.
Telephone No. 950. Tels.: "ASBESTOS, BRADFORD."

If you have any trouble with your BELTS slipping on the Pulleys, or Drying and Cracking, drop us a post card or a **Free Trial Tin** of our
Asbesteucalypt Belting Syrup.
Ask for No. 6 Catalogue.
Asbestchoucine for Rubber, Gutta, and Balata Belts.
Applications for Colonial and Foreign Agencies desired.

JAMES OAKES & CO.
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

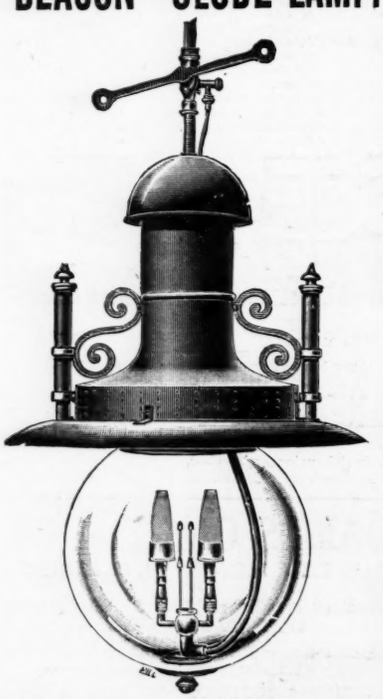
ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

HARDMAN & HOLDEN, Ld.
ESTABLISHED 1820.
SULPHURIC ACID.
MADE from Spent Oxide (free from Arsenic) and of excellent Purity. Specially prepared for Sulphate of Ammonia Manufacturers.
Works: BLACKBURN; Miles Platting and Clayton, MANCHESTER.
Head Office: Miles Platting, MANCHESTER.
Inquiries Solicited.

THOMAS TURTON AND SONS, Limited,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES, AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

THE PATENT
"BEACON" GLOBE LAMP.



Largely adopted by many Local Authorities for Public Lighting, being absolutely Shadowless and Wind-proof.

H. GREENE & SONS, Ld.,
Late of Cannon Street,
Works and Show Rooms:
19, Farringdon Road, E.C.
Registered Offices:
36, Mark Lane, E.C.
Telephone: 2669 Avenue. Telegrams: "Luminosity."

NITRATE of Thorium and Cerium, Fabrik Chemischer Praeparate von Sthamer, Noack, and Co., Hamburg.

JOHN HALL & CO.,
STOURBRIDGE,
Manufacturers of
FIRE-BRICKS, LUMPS, TILES,
GAS RETORTS.
And every description of Fire-Clay Goods.
RETORTS CAREFULLY PACKED FOR SHIPMENT.

WELDON MUD
FOR
GAS PURIFICATION,
For use in the
RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.
Full Particulars on application to the Patentees
GAS DESULPHURIZATION CO.,
— LIMITED, —
1, FENCHURCH AVENUE, LONDON, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·83 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

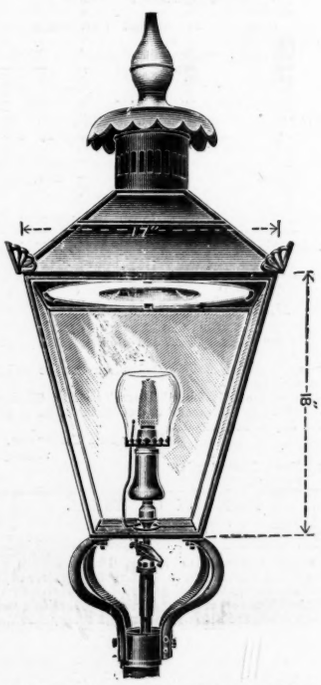
For Prices and complete Analysis, apply to
THOS. W. DANCE, SON, & HUNTER,
Coal Owners, Newcastle-on-Tyne
or
E. FOSTER & CO.,
21, John Street, Adelphi, London, W.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.
Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.
Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1806.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

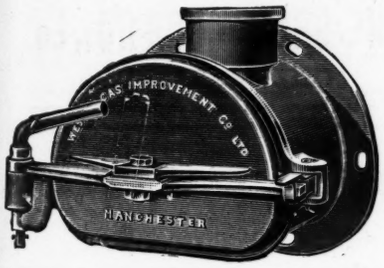
A. E. PODMORE & CO.,
Patentees and Manufacturers.
The "HOLBORN" LAMP.
Fitted with Steel Enamelled White Reflector and Chimney.



For Incandescent Gas Lighting Cheapest and Best Lamp on the Market.
25A, HATTON GARDEN, E.C.

WEST'S GAS IMPROVEMENT COMPANY, LTD.

ALBION IRON-WORKS, MILES PLATTING, MANCHESTER;
AND 104, QUEEN VICTORIA STREET, LONDON, E.C.



MAKERS OF WEST'S MACHINERY FOR

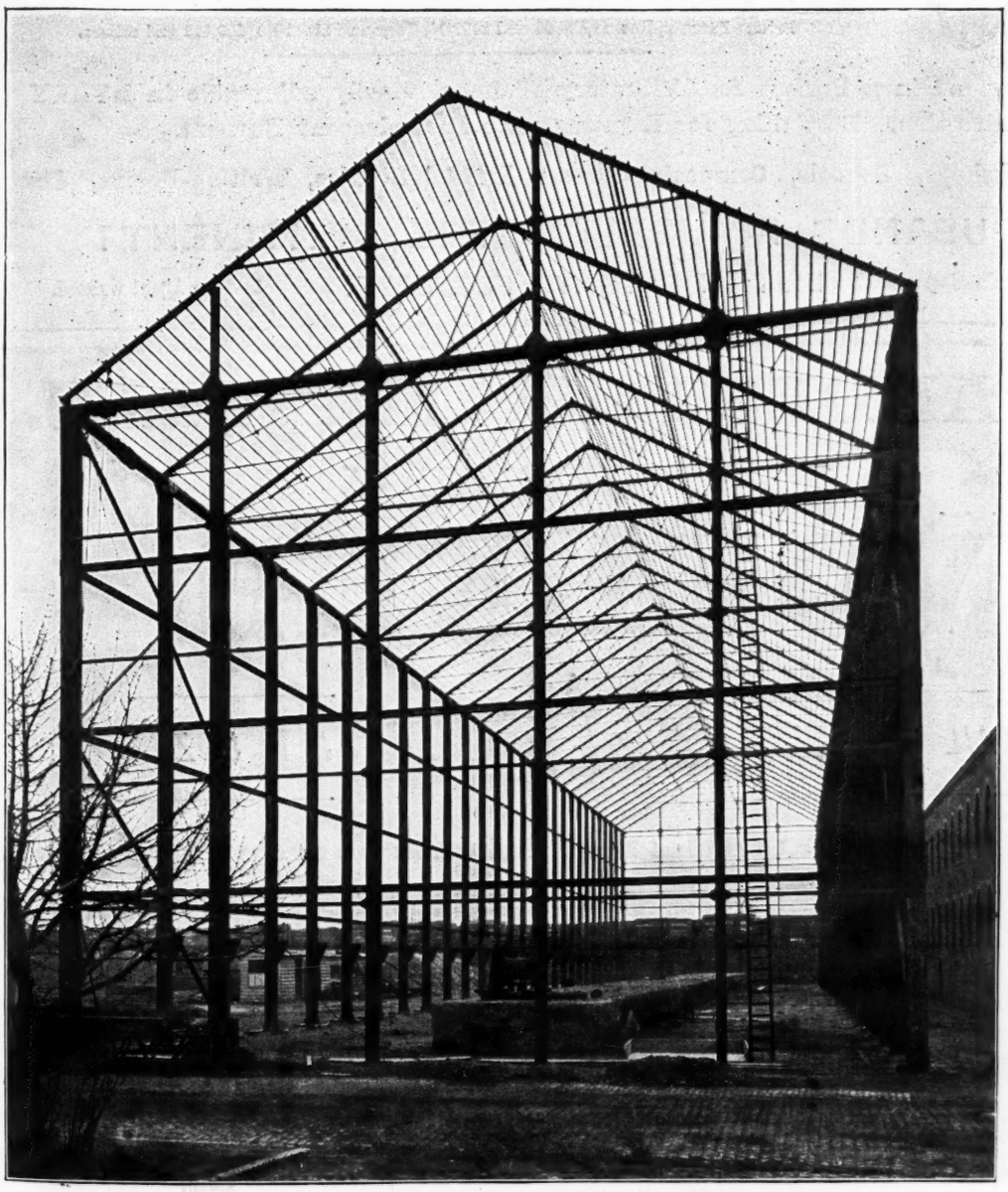
CHARGING AND DRAWING GAS-RETORTS.

WEST'S PATENT REGENERATOR SETTINGS.

WEST'S PATENT SILENT COKE CONVEYOR.

RETORT MOUTHPIECES WITH SELF-SEALING LIDS.

S. CUTLER & SONS, MILLWALL, LONDON.



EVERY KIND OF PLANT FOR GAS AND WATER WORKS.

ROOFS.
GIRDERS.
TANKS.
STEEL-FRAMED BUILDINGS.

STEEL RETORT-HOUSE RECENTLY ERECTED BY MESSRS. CUTLER.

GASHOLDERS. CARBURETTED WATER-GAS PLANT. **OIL-TANKS.**

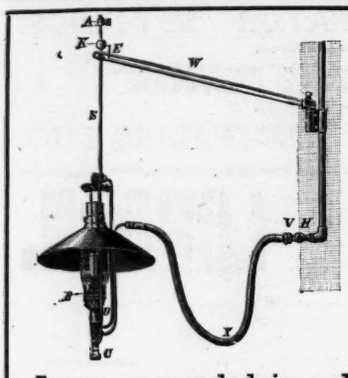
TROTTER, HAINES, & CORBETT, LIMITED,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 84, OLD BROAD STREET, E.C.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY
RAVENSTHORPE, NEAR DEWSBURY.

HEATHCOTE GAS COAL.
Rich in Illuminating Power and Yield of Gas.
Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.
THE GRASSMOOR CO., LD.,
CHESTERFIELD.



CENTRALWERKSTATT
(Branch of the **Deutsche Continental-Gas-Gesellschaft**),
at **DESSAU** (Germany).

"INDUSTRINA" Swinging Bracket for
INCANDESCENT GAS-BURNERS.
British Patents, Nos. 14,494/00 and 2010/01, German Patent No. 120,092 and others.

Lamp suspended in a Perfect Anti-Vibratory Manner. Easily adjustable in EVERY direction. Best thing for Lighting with Incandescent Burners.

Mills, Workshops, Schools, Composing-Rooms, Artists' Studios, Writing-Rooms, &c.

THOUSANDS IN USE ON THE CONTINENT!

Write for our Catalogue. BRITISH PATENTS FOR SALE. London Agent wanted.

INCANDESCENT MANTLES.

THE . . . .
VOELKER

RETAIL PRICE, **4/6** PER DOZEN.

Giving a Light equal to the best Mantles now on the Market.
No Restrictions as to the Burner to be used.

Write for a Sample and Trade Terms to the Manufacturers—

THE VOELKER INCANDESCENT MANTLE, LTD.,
ALBERT WORKS, SOUTH STREET, WANDSWORTH, LONDON, S.W.

SPECIAL MANTLES FOR STREET LIGHTING.

[SEE SUPPLEMENT TO THIS NUMBER.]

WILLEY & CO., ENGINEERS, LONDON & EXETER.

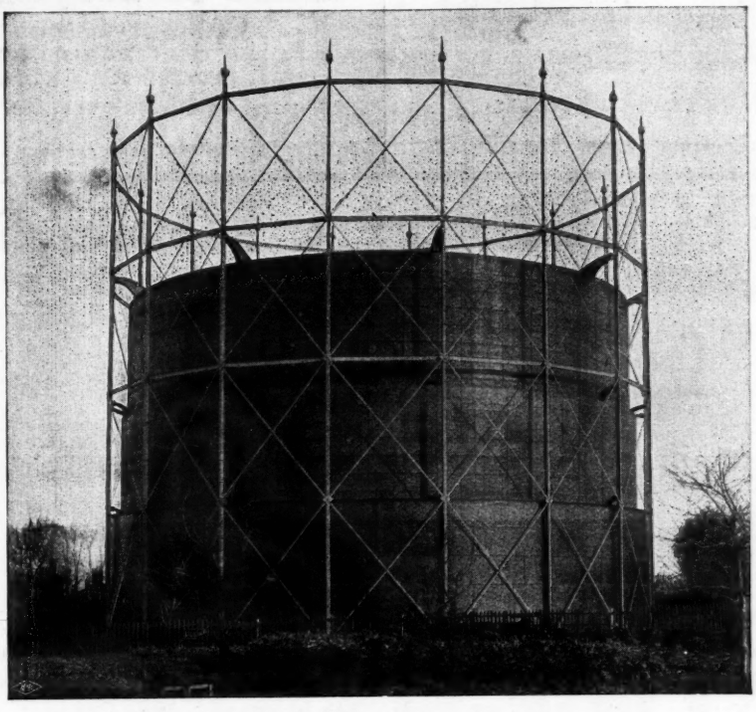
Telegrams: "WILLEY, EXETER." Telephone: 132 and 263.

GAS APPARATUS OF EVERY DESCRIPTION.

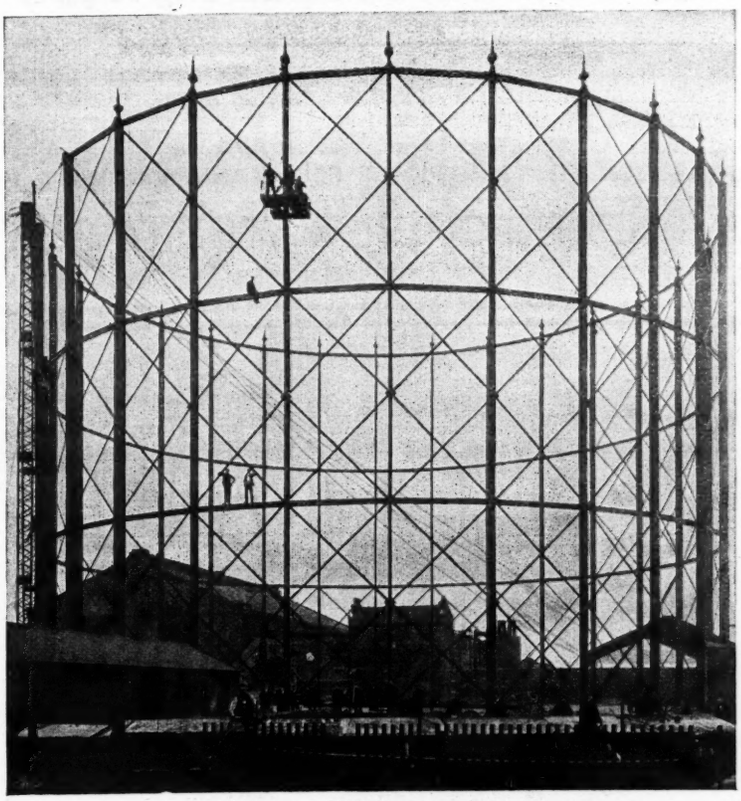
ENGINES, EXHAUSTERS AND FITTINGS.

Makers of IMPROVED WOOD GRIDS for PURIFIERS with OAK, CANE, or IRON BOLTS.

TYSOE'S SELF-SEALING MOUTHPIECES.



Three-Lift Gasholder and Steel Tank, 90 feet diameter by 14 feet deep, recently erected for the EPSOM GAS COMPANY.



Three-Lift Gasholder, 145 feet diameter by 35 feet deep, in course of construction for the WANDSWORTH & PUTNEY GAS COMPANY.

GASHOLDERS and TANKS.

RETORTS, PURIFIERS, CONDENSERS, SCRUBBERS.

GAS-GOVERNORS, STATION METERS CONSUMERS' METERS, PREPAYMENT METERS.

GAS-FITTINGS.

GAS-COOKERS.

LIVESEY WASHERS &c., &c.

Chief Offices and Works: ST. THOMAS, EXETER.

London Office: 18, ADAM STREET, ADELPHI, W.C.

WILSON CARTER & PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station, or for Export, all kinds of Fuel for Gas and Other Purposes.

ADDRESS CHIEF OFFICES:

Temple Buildings, 50, New Street, Birmingham.

THE THAMES BANK IRON CO.

UPPER GROUND STREET, LONDON, S.E.,

SUPPLY FROM STOCK

CAST-IRON RETORTS

AND ALL KINDS OF GAS-WORKS APPARATUS

SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

Sole Manufacturers of LYON'S "PATENT" GAS-MAIN SYPHONS

AGENTS FOR

ATTERTON'S PATENT APPARATUS for CHARGING RETORTS.

JOSEPH EVANS & SONS, CULWELL WORKS, WOLVERHAMPTON.

Telegrams: "EVANS, WOLVERHAMPTON." PLEASE APPLY FOR CATALOGUE No. 8. National Telephone No. 7089.

12,000 PUMPS IN STOCK AND PROGRESS.

TRADE MARK.

NO TAPPETS.

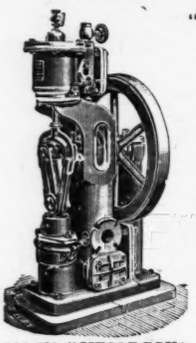


Fig. 705. "SINGLE RAM" STEAM-PUMP.

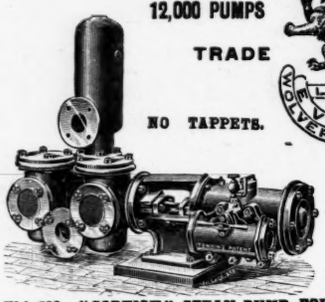


Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

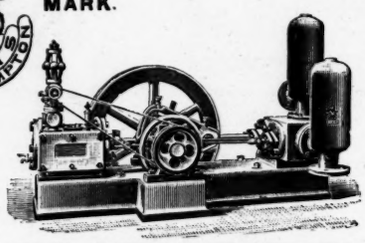


Fig. 688. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

THE DELLWIK-FLEISCHER WATER-GAS PROCESS

For Increasing the Capacity of Coal-Gas Works, also for Incandescent Lighting, Driving of Gas-Engines, and Manufacturing Purposes.

(PATENTS IN ALL COUNTRIES)

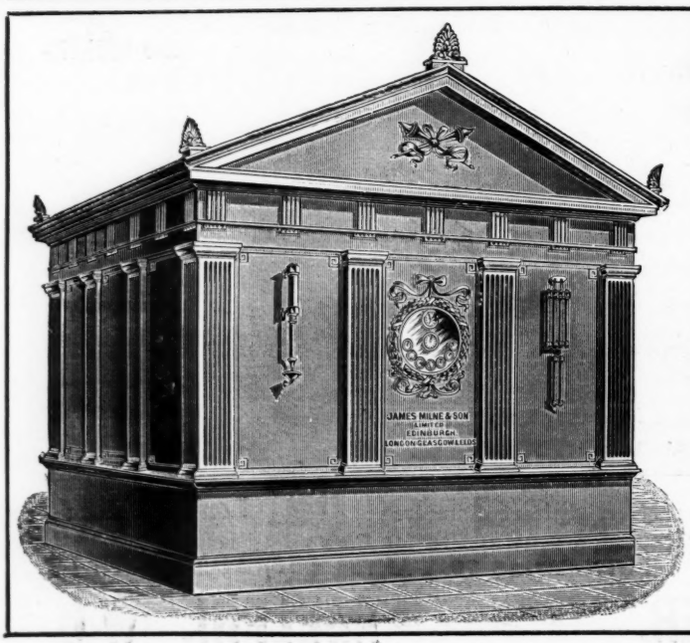
Plants contracted for within the last Eighteen Months for the following Gas-Works: WEST BROMWICH, KÖNIGSBERG, ISERLOHN, LYONS, ERFURT, REMSCHEID, PFORTSHEIM, PLAUEN, BARMEN-RITTERSHAUSEN, NUREMBERG, BRUMMEN,* OSTERFELD,* WARSTEIN,* WIBORG.*

[* Blue Water Gas with Incandescent Burners.]

ALSO TWENTY-SEVEN INSTALLATIONS FOR MANUFACTURING PURPOSES.

THE DELLWIK-FLEISCHER WATER-GAS SYNDICATE,

25, VICTORIA STREET, WESTMINSTER, LONDON, S.W.



JAMES MILNE & SON, LTD.

Milton House Works EDINBURGH.

LONDON. GLASGOW. LEEDS.

List of STATION METERS

RECENTLY ERECTED AND IN HAND.

GLASGOW	150,000	cubic feet per hour.
DUNDEE	150,000	,, ,,
PAISLEY	150,000	,, ,,
EDINBURGH	125,000	,, ,,
LEEDS	100,000	,, ,,
MIDDLESBROUGH	100,000	,, ,,
WEST HARTLEPOOL ..	100,000	,, ,,
HAMILTON	80 000	,, ,,
KIRKCALDY	80,000	,, ,,
PERTH	80,000	,, ,,
COATBRIDGE	60,000	,, ,,
WOOLWICH	50,000	,, ,,
YEADON	50,000	,, ,,
LINCOLN	45,000	,, ,,
HAWICK	40,000	,, ,,
REDCAR	30,000	,, ,,
INVERNESS	25,000	,, ,,
WISHAW	25,000	,, ,,
BEVERLEY	25,000	,, ,,
HINCKLEY	20,000	,, ,,
WORKINGTON	20,000	,, ,,
ECCLESHILL	15,000	,, ,,

SCOTT-SNELL
SELF-INTENSIFYING LAMP.

Automatic Action.

No Complex Mechanism.

"Power" Free of Cost.

TYPE OF SCOTT-SNELL LAMPS
NOW IN USE
AT THE GLASGOW EXHIBITION.

INTENSIFIED LIGHT

WITHOUT Compressing Plant, Special Gas-Service, Water Bill, Gas-Engine or other Pumping Appliances, tearing up of Roadways, or interference with existing Service.

The **SCOTT-SNELL LAMP** may be set to give any pressure from **4** inches to **36** inches of Water; **8** inches to **10** inches is usually preferred.

Lanterns supplied with Single, Duplex, or Cluster of Burners.

TO GAS ENGINEERS AND MANAGERS.

At the Stand on the North Bank of the Kelvin, an attendant will be pleased to give full explanation, and to show the action of the Lamp.

This unique Illustration of Wasted Bye-Products (heat in escaping products of combustion) effecting, without cost, all that is elsewhere reached by special motive power and special distributing Mains, should not be missed.

350 to 500 Candles from a Single Burner, with an efficiency of 35 Candles per cubic foot of Gas.

The ONLY High-Pressure Lamp.

THE LAMPS MAY BE INSPECTED AT ANY TIME BY APPOINTMENT.

THE SCOTT-SNELL SELF-INTENSIFYING GAS-LAMP COMPANY, LTD.,

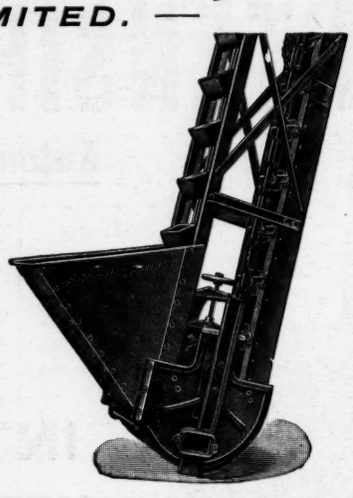
Telephone No. 559 Westminster.
Works: 29, GILLINGHAM STREET, S.W.

53, Victoria Street,
WESTMINSTER, S.W.

BARRY, HENRY, & CO.,

— LIMITED. —

Specialities:
TRANSMISSION OF POWER.
Rope and Belt Pulleys,
Spur and Bevel Wheels,
Shafting and Couplings,
Pedestals, and Fixings.



Specialities:
TRANSMISSION OF MATERIALS.
Conveyors,
Elevators,
Grinding Machinery,
Motors.

WORKS:
ABERDEEN,
SCOTLAND.

AND
64, MARK LANE,
LONDON, E.C.

Telephone No.
756 BANK LONDON.

Telegraphic Address:
"ROBUSTNESS, LONDON."

ESTABLISHED 1873.
Contractors to H.M. Government.

RETORT-SETTINGS

INCLINED, REGENERATIVE, GENERATIVE, AND FLOOR LINE.
SEVERAL THOUSANDS OF OUR SETTINGS IN SUCCESSFUL WORK.

Plans, Estimates, and full Particulars for Complete or Partial Erection and Renewal.

J. & H. ROBUS,

Engineering Contractors for Gas and Water Works,
20, BUCKLERSBURY, LONDON, E.C.,
And GORING, OXFORDSHIRE.

GASHOLDER
TANKS.
RESERVOIRS.

MAIN LAYING.
BORING.
WELL SINKING.

JONAS DRAKE & SON,

OVENDEN, HALIFAX,

HAVE ERECTED **500** OF THEIR PATENT

TUBE REGENERATOR

FURNACES DURING THE LAST **4** YEARS.

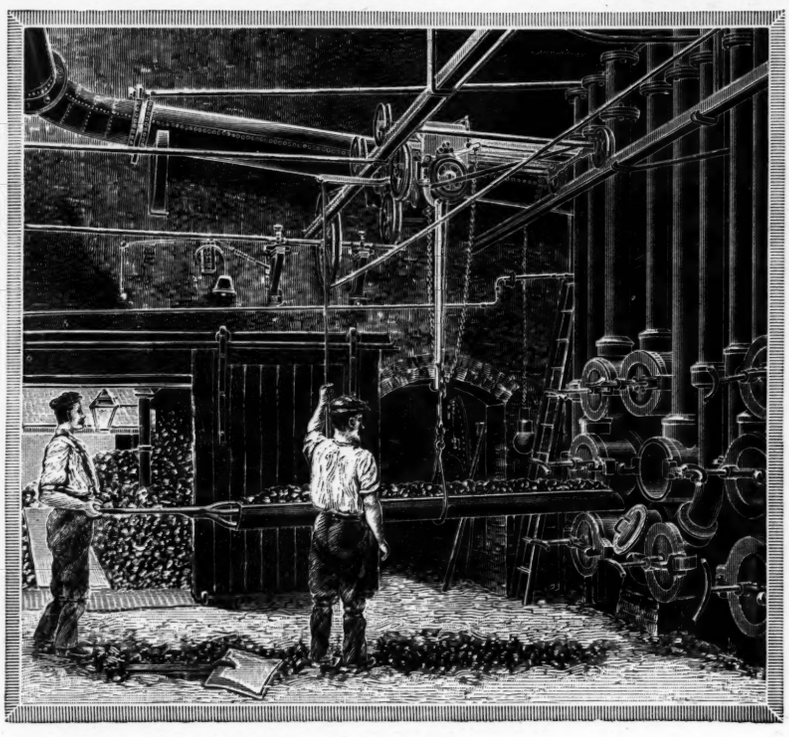
ESTIMATES ON APPLICATION.

Telephone No. 43.
HALIFAX EXCHANGE.

LONDON OFFICE:
34, VICTORIA ST., S.W.

Telegraphic Address:
"DRAKESON HALIFAX."

Horizontal Retort Charging Revolutionized



THE PATENT

"RAPID"

POWER CHARGING APPARATUS

FOR GAS-WORKS.

Can be seen at work by appointment.

Biggs, Wall & Co.

13, CROSS STREET, FINSBURY,

LONDON, E.C.

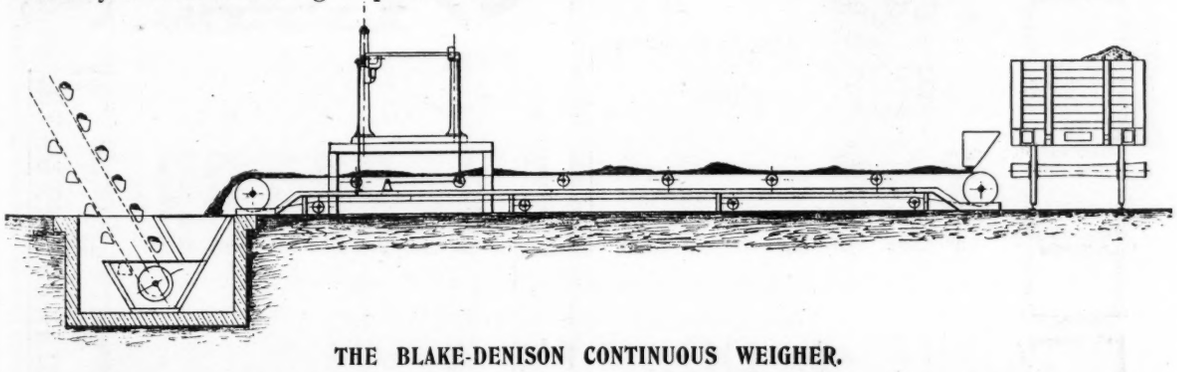
TELEGRAPHIC ADDRESS:

"RAGOUT, LONDON."

CONTINUOUS COAL WEIGHING & RECORDING.

THE ONLY CONVEYOR WEIGHING-MACHINE IN THE MARKET.

In conjunction with Messrs. Sam. Denison & Son, Weighing-Machine Makers, of Leeds, we have successfully designed a Machine for Weighing Coal, Ores, and other Materials in bulk, while passing on a Conveyor. The Machine weighs accurately, requires no attention, and automatically records the Weights passed over.



THE BLAKE-DENISON CONTINUOUS WEIGHER.

BLAKE, BARCLAY, & CO., VICTORIA WORKS, GREENOCK.

Branch Office: 110, CANNON STREET, LONDON. Head Office: GREENOCK.

Telegrams: "FILTER, GREENOCK." Codes: A1., A.B.C.

THE WELL-KNOWN . . .

"SWANBRAND"

NITRATE OF THORIUM,

CERIUM, AND OTHER SALTS

FOR MAKERS OF

INCANDESCENT MANTLES.

All Materials guaranteed first class.

Dr. O. KNOEFLER & Co., Ploetzensee-Berlin.

Sole Agents for United Kingdom and Colonies:

J. NORRENBERG & CO.,

Cannon Street Buildings, 139, Cannon St., London, E.C.

ARROL-FOULIS

Patent Automatic Machinery

FOR

DRAWING AND CHARGING

GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

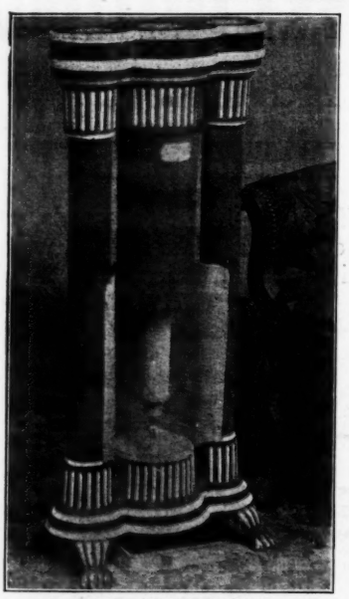
SIR WILLIAM ARROL & CO., Limited,

GLASGOW.

[See Illustrated Advertisement, Sept. 3, p. 549.]

THE "LUX-CALOR" TRADE MARK.

RITCHIE'S PATENT



D3 LUX-CALOR.

This Stove is let on Hire by the leading Gas Companies.

Full Particulars and Prices from

RITCHIE & CO.,

Contractors for Automatic Supplies to the Gaslight and Coke Company and the South Metropolitan Gas Company,

46, HATFIELD STREET, SOUTHWARK, S.E.

LONDON. TELEPHONE 1533 HOP.

CASES FOR BINDING

VOLUMES OF THE "JOURNAL"

(GREEN CLOTH, GILT LETTERED)

MAY BE HAD OF THE PUBLISHER

PRICE 2s. EACH.

Incandescent

GAS LIGHTS

Made in Birmingham.

All Materials best quality.

Trade Prices of BURNERS, 4s. 6d. Dozen, or with Galleries 7s. 6d. Dozen.

Trade Prices of MANTLES, 4s. Dozen. 42s. Gross. £14 per 1000.

Cash with Order.

Samples 1/3 post free.

NOTICE.—The Birmingham Incandescent Lighting Company, Ltd., actually Manufacture ALL Mantles sold by them, and DO NOT USE OXIDE OF CERIUM. They therefore CANNOT BE INFRINGEMENTS, even supposing the Welsbach Patent to be valid.

THE

Birmingham Incandescent Lighting Co., Ld.,

280, Broad St., Birmingham, and 230, Market Place, Dudley.

MAURICE GRAHAM.

CONTRACTORS TO H.M. GOVERNMENT.

GRAHAM, MORTON & CO LTD

WORKS:

LEEDS.

ELEVATORS & CONVEYORS.

INCLINED RETORTS.

PHOTO, SHOWING ELEVATOR FOR COLD COKE.

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, & ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible and other Stourbridge Clays.

Manufacturers of Glasshouse Pots and Crucibles of every kind.
Established 1836.

JOSEPH CLIFF & SONS,
INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.
WORTLEY, LEEDS.

LONDON OFFICES & DEPÔTS:
Baltic Wharf, Waterloo Bridge.
WHARVES NOS. 2 & 4, INSIDE G.N.
GOODS YARD, KING'S CROSS, N.
LIVERPOOL:
16, Lightbody Street.
LEEDS:
Queen Street.

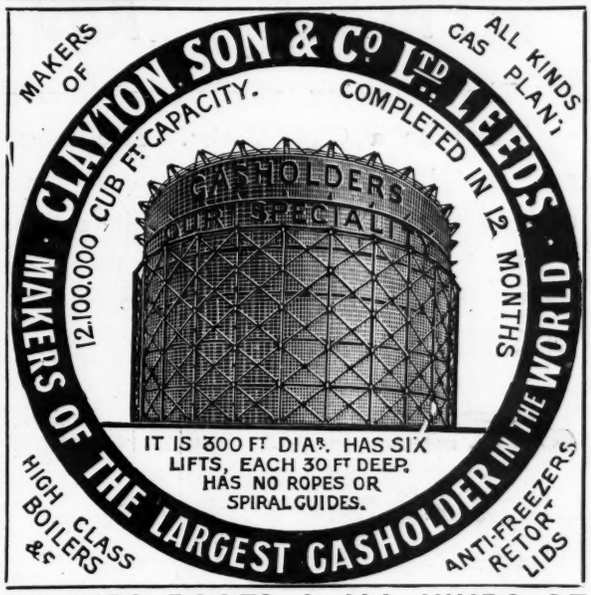
MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.
Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

BOWENS' Ltd. Successors,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS; INCLINED, HORIZONTAL, and SECTIONAL RETORTS; LUMPS, TILES, &c., of every description.
ESTABLISHED 1860.


MAKERS OF
CLAYTON, SON & Co LTD LEEDS.
ALL KINDS GAS PLANT
COMPLETED IN 12 MONTHS
12,100,000 CUB FT CAPACITY.
GASHOLDERS
OVER SPECIALITY
IT IS 300 FT DIAR. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
MAKERS OF THE LARGEST GASHOLDER IN THE WORLD
HIGH CLASS BOILERS &c
ANTI-FREEZERS RETORT LIDS

GIRDERS, ROOFS, & ALL KINDS OF
STRUCTURAL IRONWORK.

London Office: 60, QUEEN VICTORIA STREET, E.C.
Telegraphic Addresses: "GAS, LEEDS." "ECLAIRAGE, LONDON."

R. & J. DEMPSTER, LD.,
Telegraphic Address: "SCRUBBER, MANCHESTER."
National Telephone: Nos. 54 and 2296.

IMPROVED
Water-Cooled Condensers
MANCHESTER.

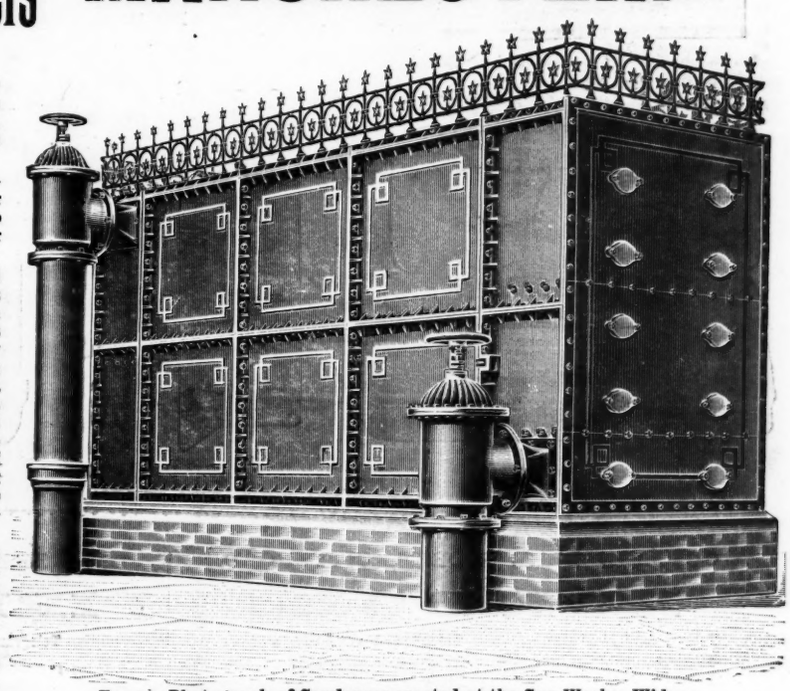
This water-cooled Gas Condenser is designed to work against the great variations of temperature between day and night, sunshine and shade, summer and winter, which are found in this and other countries.

Water being the cooling medium, the temperature of the gas can be kept under control better than with air; and the gas can be sent forward to the purifying plant at the proper temperature for efficient and economical purification.

The cold water enters at the bottom, and gradually rises to the top as the water absorbs heat, thus causing the warm gas to meet the warm water first, and to leave the Condenser in contact with water at any desired temperature by simply regulating the feed-water tap. The gas is thus **cooled progressively, uniformly, and effectually.** The simple construction of this Condenser affords a large cubical capacity, so that the gas remains in a considerable time, and secures all the advantage due to slow-speed condensation. Every part of the Condenser is easily accessible, and by removing the end plates the whole of the interior can be got at. It can be erected under cover, and protected from extremes of heat or cold.

R. & J. DEMPSTER, LTD., recommend this Condenser to be used as a Finishing Condenser, after the gas has already passed through the ordinary Annular or Air Condensers.

Condensers of this type equal to 10,500,000 cubic feet per 24 hours already erected and at work.



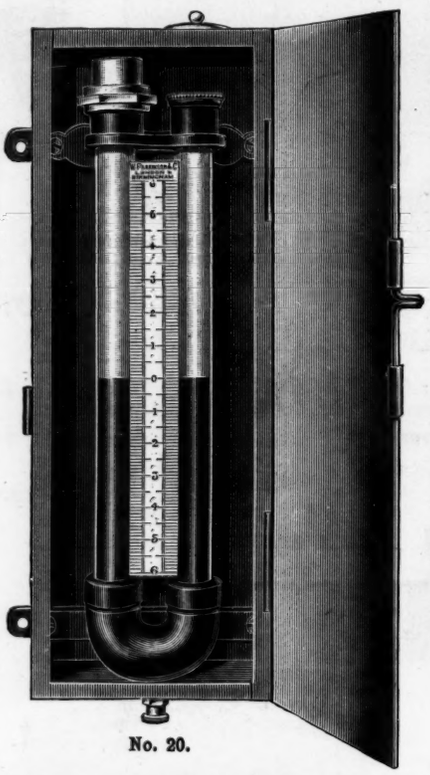
From a Photograph of Condenser erected at the Gas-Works, Widnes.
Capacity 1,500,000 cubic feet per 24 hours.

PARKINSON AND W. & B. COWAN, LTD.

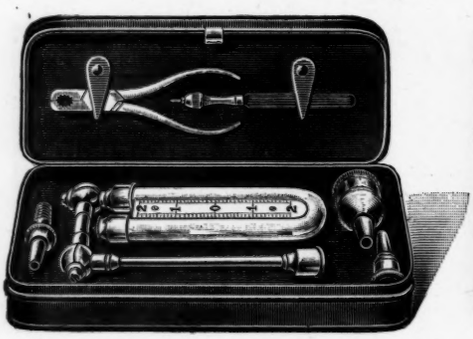
(PARKINSON BRANCH.)

PRESSURE AND VACUUM GAUGES.

The following engravings show a variety of Gauges adapted for different positions on a Gas-Works. The mountings are either of white metal, brass, or gun metal. We pay the greatest attention both to the finish of the mountings and to the selection of the glass tubes used, while every gauge is thoroughly tested for soundness before leaving our works.



No. 20.



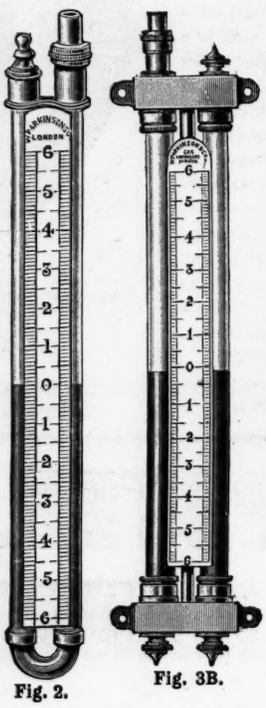
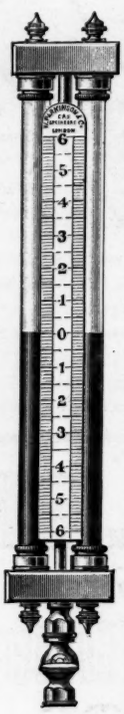


Fig. 2.

Fig. 3B.

Fig. 1.



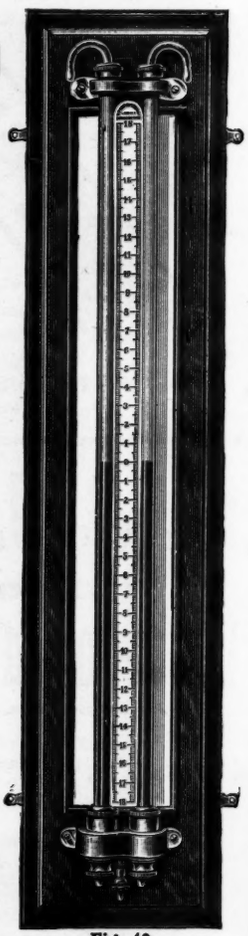
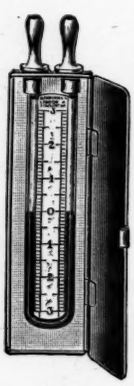


Fig. 10.



No. 30.

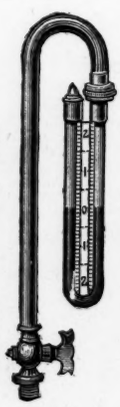
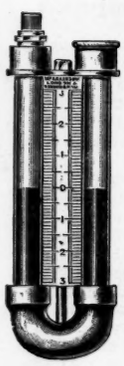


Fig. 6.



No. 28.

Fig. 9.

COTTAGE LANE WORKS, CITY ROAD.

LONDON.

Telegrams: "INDEX." Telephone No. 778 King's Cross.

BELL BARN ROAD WORKS,

BIRMINGHAM.

Telegrams: 'GASMETERS." Telephone No. 1101.

[See also Advt. p. 686.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Olding, Ltd., 12, Gough Square), and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Sept. 17, 1901.